Compressed Air Magazine

VOLUME 46 · NUMBER 7

JULY 1941

LONDON · NEW YORK · PARIS

FRIANT DAM, CALIFORNIA

ON THE COVER

OUR cover picture shows the Friant Dam, on the San Joaquin River near Fresno, Calif., as it appeared on June 2. At that time, only nineteen months after the commencement of the work, 1,000,000 cubic yards of concrete had been poured. The Friant Dam is a unit in the Central Valley Project, being a companion structure to Shasta Dam which we pictured on our cover last month. It is being built for the U. S. Bureau of Reclamation by Griffith Company and Bent Company. A description of the project will be published in a forthcoming issue.

•

IN THIS ISSUE

EVERY western mining state has its quota of derelict towns that are short on future but long on past. Many of them once dreamed of being metropolises, but their bloom was nipped in the bud. Colorado has an abundance of these fading municipalities because the Fifty-niners built on surface showings of ore and assumed that beginner's luck would last indefinitely. The wily promoter also had a lot to do with overbuilding. He often used stockholders' money to dig deep holes that never had a chance of returning a profit. Regardless of their origin, the ghost camps had a merry time of it in their prime, and some of them have rich memories of pompous pasts. Our leading article takes up a few of the many volatile municipalities of Colorado's early mining era.

•

THE Calyx drill is becoming increasingly important in construction, mining, and engineering undertakings of various kinds. New uses for it are being discovered all the while, and established ones are being exploited more and more. Our second article outlines its principal fields of application and describes the equipment and its operation. It is followed by a 3-page human-interest account of a core-drilling expedition that was made when heavy, cumbersome equipment had to be transported by slow methods.

•

THE American Indian was pretty much of a novice in the matter of engineering and construction, preferring to get along with the simplest of structures even though discomfort was his lot most of the time. The Iroquois tribes were farther advanced along these lines than their contemporaries, and it is of their works in New York State that our final article treats.

Compressed Air Magazine

Volume 46 JULY, 1941 Number 7

C. H. VIVIAN, *Editor*
A. M. HOFFMANN, *Assistant Editor*
J. W. YOUNG, *Advertising Manager*
J. F. KENNEY, *Business Manager*
D. Y. MARSHALL, *European Correspondent*, 243 Upper Thames St., London, E.C.4.
F. A. McLEAN, *Canadian Correspondent*, New Birks Bldg., Montreal, Quebec.

EDITORIAL CONTENTS

ADVERTISING INDEX

A monthly publication devoted to the many fields of endeavor in which compressed air serves useful purposes. Founded in 1896.

CCA Member Controlled Circulation Audit.

Published by Compressed Air Magazine Company. G. W. MORRISON, president; J. F. KENNEY, vice-president; F. E. KUTZ, secretary-treasurer.
Business, editorial, and publication offices, Phillipsburg, N. J.
Advertising Office, 11 Broadway, New York, N. Y., L. H. GEYER, representative.
Annual subscription price: domestic, $3.00; foreign, $3.50. Single copies, 35 cents.
Compressed Air Magazine is on file in many libraries and is indexed in Industrial Arts Index.

Ghost Camps

C. H. Vivian

Photos from Thomas J. Barbre and V. B. Souders

WHEN Cripple Creek, Colo., was in its first flush of gold excitement and there had not yet been time to construct any of the three railroads that eventually served it, heavily laden ore wagons, drawn by from four to eight mules, moved in almost endless procession to the Town of Divide, on the Colorado Midland Railway. Some 10 miles out of Cripple Creek, where the roadway skirted the shoulder of Pike's Peak, a rock protruded from the ground in one of the furrows that the wheels had worn. There were rocks aplenty throughout the course of the crude highway, but only this particular one concerns this narrative.

One day a driver, who hadn't mastered the fine points that go to make up the now almost lost art of mule-skinning, reached back on his load, picked up a choice specimen of calaverite, and let it fly at one of the lead mules with perfect aim. The animal gave a jump that added impetus to the wagon just as the left front wheel came against the jutting rock. The resulting jolt jostled a 50-pound chunk of ore off the load, and it rolled down the gentle slope for nearly 150 feet before coming to rest in the entrance to a badger hole. It so happened that the gold-bearing missile that had been cast at the mule ricocheted off the animal's back and took a course that deposited it on the same side of the road as the larger piece of ore and less than 200 feet away from it. Several months passed. The deep snows of winter descended, and in the spring they melted and formed rivulets that carried sediment. The sediment filled up the badger hole and piled up around the large piece of calaverite so that only its top was exposed. The smaller specimen was also partially buried where it lay among the young shoots of grass that were just breaking forth under a friendly sun.

During the following summer a prospector roamed over the region. He knew little of gold ore or of its mode of occurrence, for until a few weeks previously he had been leading the prosaic life of minister of the gospel in a Minnesota town. Like thousands of others he had read of the fortunes that were being dug from the ground "out West," and he had forsaken the cloth for a more adventuresome existence that held the promise of greater monetary reward. In Cripple Creek he had seen enough calaverite to acquaint him with its general appearance, and he had taken to the hills in search of it.

Learning that the area within 5 miles of Cripple Creek had been gone over in every direction like with a fine-tooth comb, he drifted farther afield. Chance led him to the spot where the large piece of ore lay, and he fell frantically to work digging it out. Beneath it and on all sides of it he found only the light-brown granular earth that is formed by the disintegration of granite, and there was no sign of mineralization. He had heard the miners in Cripple Creek speak of float rock, and he concluded that such was his find. Somewhere nearby, he reasoned, was the mother lode from which this boulder had broken off. But if one piece had become detached from the vein, others must have done likewise. Accordingly, he renewed his quest for supporting evidence of a proximate bonanza. Diligent search uncovered the small piece of ore that had bounded from the lead mule's back. The minister then was sure that he was hot on the trail of a treasure trove.

For several days he traveled a continually widening circle, probing here and there with his pick, but without success. It became evident to him that he must delve below the surface, that he must remove the mantle of soil that was hiding the vein from view. That called for money to hire men and to buy simple machinery. His funds were meager, so rather than appeal to comparative strangers in Cripple Creek, and thereby probably precipitate a rush that might deprive him of his prize, he wrote to members of his congregation in Minnesota and implored their financial assistance, in return for which he promised a substantial interest in the profits which he felt confident would accrue.

The good churchmen in the Minnesota

WHERE SILENCE REIGNS

Views of the one-time bustling gold camp of Tincup, Colo., which was so named because its discoverer, lacking a regulation pan, washed the gravel in a large tin cup. The picture at the top of the opposite page shows a part of what was once the main street. The deserted cabin below it has a roof made of flattened tin cans. All that remains of the cemetery, on a hill overlooking the town site, is seen at the left. The safe was left where it lies after fire had destroyed the general store in which it stood.

A COMPRESSOR THAT RUNS NO MORE

In the foreground is an Ingersoll-Sergeant Class A steam-driven air compressor at the site of the former Golden Fleece Mine near Lake City, Colo. The machine was built in 1896 and saw many years of service. In 1874, Enos T. Hotchkiss, who had previously mined in Nevada, discovered gold ore near Lake City while supervising the building of a road into that then isolated area. He staked his find, returned later, and developed it into a paying property. He also staked out Lake City, which numbered 350 buildings and 1,500 residents within a year. In 1881, a single store there did a business of $500,000. One night Hotchkiss walked into the mine adit without a candle, took the wrong passageway at a fork, and fell down a shaft. He was a long time recuperating, and during his absence the vein was lost, profits ceased, and in 1878 the property was sold to satisfy a $16,000 debt. The new owners named it the Golden Fleece and found rich ore, shipping single carload lots of petzite worth $50,000. For a considerable period the mine paid dividends of 24 per cent annually. Eventually it waned and was abandoned.

town not only sent money but many of them delivered it in person and lent a hand in seeking the supposed vein of gold ore. As a result, windlasses and buckets were procured, and pick-and-shovel brigades began penetrating the earth's crust. The operations attracted attention, and word of a new "strike" soon spread like wildfire through Cripple Creek and other camps in the state. Hundreds of hopeful prospectors hotfooted it to the scene of activity and raced one another in staking out claims. More picks, shovels, and windlasses appeared, and soon an army of workers was tearing up the landscape.

Because those who dug had to eat, sleep, and be diverted from their labors, more men came to set up stores and houses and amusement places. Almost overnight a town came into being—Gillett—and every day it grew through its own momentum, like a snowball rolling down hill. Real-estate men arrived on the scene and began selling lots. Streets were laid out, and a water system sufficient to serve several thousand persons was installed. Meanwhile, all the frantic digging produced nothing more than a lot of holes in the ground and mounds of brown earth beside them. Gradually it dawned upon the populace that Gillett was not destined to become a second Cripple Creek, and the fortune seekers began to move on to investigate other "finds." In a few months the town was deserted.

In after years most of the buildings were torn down by salvagers, and others rotted and collapsed. Today an automobile road between Colorado Springs and Cripple Creek passes within a quarter-mile of the site. There is a sign post on it on which is inscribed "Gillett," and a hand points toward the base of Pike's Peak. If you will take the trouble to follow the course it marks, you will come upon a few houses, a fireplug here and there, and numerous mounds of dirt, each with a caved-in excavation beside it. One heap is larger than the others. It is the one that was built by the minister.

The West has many of these "ghost" camps. Some, like Gillett, died aborning. There was never any ore to give them the breath of life. Most of them, however, have known days of opulence—boom days—during which they gave the world sizable sums in gold and silver and made men wealthy almost overnight. Life coursed through their now silent streets. Some have been entirely forsaken by human beings, and only their toppling skeletons remain. Others have heard the requiem of their mining activities but are still peopled by a few of the old guard who hold to their homes because they have no other place to go. Still others are facing municipal death but are hanging on, fighting the inevitable. The ore comes from the ground in driblets now, but each driblet is an extension of the

GILLETT

Remains of a town that enjoyed a short but lusty life because a former Minnesota minister mistook a piece of ore that had fallen off a load in transit for float rock. Note the fire hydrant in the left foreground. It was part of a system that was laid out to supply water to several thousand persons. The railroad that is shown was run into the camp after it was founded and now goes to Cripple Creek.

OLD METALLURGICAL WORKS

During the lead-silver boom at Leadville in 1878, prospectors crossed the mountains to the Tenmile District where some placer and lode mining had been carried on a dozen years earlier. Finding some carbonate ores, they envisioned a second Leadville and constructed treatment works for a production that failed to materialize. The Town of Kokomo which they founded grew rapidly and declined with equal speed. These pictures show the skeletal remains of two smelters and a large mill that were erected there.

lease on life. At the same time, it is bringing their doom that much nearer. They may be likened to a castaway on a barren island who munches each bite of his food knowing full well that it hastens the time when he will die of starvation.

Taxes are a bugbear in a declining camp. As a town grew, water, lights, and other improvements were provided and bonds issued to defray their cost. No one felt the taxes during the boom days; but as a camp dwindled the valuation decreased to a point where an almost prohibitive levy was necessary to meet sinking-fund requirements. The present total tax rate in many of these camps is more than 8 per cent, and in some it is more than 12 per cent. The municipalities own most of the property, the original owners simply having moved away and left whatever they had. There is no market for the real estate other than a limited one created by persons who desire a place where they can spend a summer vacation in the coolness of the mountains. Many of the deserted homes are partially furnished—just as they were left by the owners who intended to return but never did. It is possible today to buy a commodious house in many of these western mining towns for from $200 to $500. So many of the earlier camps were volatile affairs that prospectors and miners came to the conclusion that all cities lacked stability. Upon this mental attitude is based the classic story of the prospector who returned from a visit to New York with the comment that "it looks like a permanent camp."

Accompanying illustrations show the present appearance of some former prosperous and populous Colorado mining camps that are now "on their uppers." Lest the reader gain a wrong impression, it should be pointed out that Colorado is still very much a mining state, its output exceeding $30,000,000 annually. Cripple Creek, Alma, the San Juan region, and Boulder, Gilpin, and Clear Creek counties still have good gold mines; the Climax near Leadville produces two-thirds of the world's molybdenum; and silver, lead, zinc, copper, tungsten, and various other minerals are being obtained in large quantities. The fact is that no really important mining town in the state has ever declined to ghost-camp status. Most of those referred to in this article were either founded on poor judgment or on indications of extensive mineralization that failed to materialize. In some cases they were forsaken not because the ore gave out entirely but because there was no process available for treating the complex ores profitably. It is entirely within the realm of possibility that, with the present advanced metallurgical technique, many of the abandoned mines could be made to pay and that some of them will one day be revived.

Mining camps, especially gold-mining camps, die hard because there are usually some persistent claim owners who refuse to accept the death sentence. These recalcitrants hang on doggedly, and a few of them never leave until they are carried to their graves. Take the case of Ophir, Colo. Once a thriving camp, it had shrunk to a population of 29 in 1930. The 1940 census reveals that two inhabitants are still hanging on and maintaining the town as an incorporated municipality. Nevadaville, where men who later became mining millionaires once lived, was down to one resident a few years ago.

Colorado's mining era began on January 7, 1859, with the discovery of rich placer ground on Chicago Creek, near the present site of Idaho Springs, by George A. Jackson of Glasgow, Mo. He was one of the many who had crossed the plains in covered wagons during the previous year to seek adventure and fortune. Few of them knew anything about mining, and the majority looked for gold in the beds of streams where they emerged on the plains from the foothills of the Rockies. These deposits were too lean to yield good returns to hand workers, and the Argonauts were rapidly becoming discouraged. Meanwhile additional parties continued to arrive from the East, and their first question invariably was: "Where are the gold fields?"

Sensing that the flakes of metal found in the stream gravels came from veins

back in the mountains, Jackson, among others, followed Clear Creek westward toward its source among the high peaks of the Continental Divide. Arriving at a point where the stream forked, he took the left-hand branch. A few miles farther on he reached the place where Chicago Creek enters the larger stream. Attracted by mist rising from a hot spring, which he mistook for smoke from the fire of Ute Indians, he proceeded up the tributary. Although it was the dead of winter and cold, the warm water from the spring had kept the nearby ground from freezing, and Jackson tried panning some of the gravel at the edge of the stream. In a short time he had $9 worth of gold. He went back to Golden, the outfitting point for the mountains at the base of the foothills where he had left some of his friends, and returned with 22 men. In seven days they panned gold worth $1,900. Jackson took the proceeds to Aurora, near Denver, and began buying up the belongings of disappointed immigrants who sought funds with which to return to their homes. His possession of so much gold dust caused great excitement and much questioning as to where he got it. Every move he made was watched. Knowing that he would be followed when he returned to the mountains he divulged the location of the placer deposit, and a rush ensued.

At the time Jackson had made his previous trip to Golden he had talked with one John Gregory and agreed to meet him on Vasquez Fork, the left or south branch of Clear Creek. Gregory apparently forgot the instructions, for he took the north branch. Naturally, he failed to find Jackson; but he did discover the famous Gregory lode near the site of what later became Central City. People literally swarmed into the Gregory and Jackson "diggings," and soon all the ground that showed evidence of mineralization was staked out. The prospectors fanned out, and some of them crossed the Divide into South Park, where they made mineral discoveries and founded towns.

Among the first settlements established was one that bore the picturesque name of Buckskin. This came about because Joseph ("Buckskin Joe") Higginbottom, one of the six men who found gold nearby, always wore buckskin clothing. The principal mine was the Phillips, and the certificate of its location listed its owners as Buckskin Joe & Co. The mine yielded $300,000 in oxide-gold ore in two years. During the first summer, 24 stamps, that had been freighted across the plains, and a dozen *arrastres* were set up for treating it and the ore from other properties. By 1862 there were in operation nine mills with 78 stamps.

The town was laid out in 1860. It was not called Buckskin originally, for it was decided to name it for the only two women in camp, Mrs. Laura Dodge and Mrs. Jeanette Dodge. Their first names were combined into the word "Laurette." For some reason, which history does not divulge, this was changed in 1862 to Buckskin. At its height, the camp had about 1,000 inhabitants. According to the historian Hall, "the district prospered amazingly, saloons multiplied, and Buckskin developed into one of the very brisk and breezy settlements of the country." A short distance below the surface, the free-milling, gold-bearing quartz gave way to iron and copper pyrites. As these sulphide ores could not be treated in the stamp mills, mining ceased, and in a relatively short period the district was almost deserted. Its production from 1859 to 1866 is unofficially reported as $1,600,000. In 1864 a store was conducted in Buckskin by H. A. W. Tabor, who was later to attain riches and political importance in Leadville, only a few miles away.

St. Elmo, Chafee County, which still harbors a few persons, rose to prominence around 1880, following the working of lode deposits that had been discovered in 1875. Much New York and St. Louis capital was invested there, and numerous tunnels were driven at lower levels to intersect veins that outcropped on the surface. The Mary Murphy and Pat Murphy mines were good producers for several years, but eventually became losing ventures. Two newspapers were published in St. Elmo at different periods. The latter received many of its supplies through the Town of Tincup, 15 miles away and across a mountain range in Gunnison County. Placer gold was found there in 1861 by Fred Lottes. Lacking a regulation gold pan, he used a tin cup to wash the gravel, and from that act the place derived its name. Now little more than a memory, Tincup was a thriving community for many years, and in 1881 was large enough to support a bank.

Pitkin, a town in Gunnison County that bears the name of a former governor of Colorado, F. W. Pitkin, was founded in 1879 on the strength of important mineral discoveries nearby. Two years later it had a population of 1,500, many stores and saloons, hotels, a newspaper, and a bank, and mining claims were as numerous as its people. A small remnant of its past glory remains; but mining activity is insignificant as compared with what it once was. Pitkin is located near Crested Butte, which deserves mention because near it is located one of the few anthracite-coal deposits of the West.

One of the primary needs of Colorado's early mining industry was suitable reduction plants. The surficial gold ores were of the oxidized type, and the mineral could be recovered by crushing the rock under heavy stamps and sluicing it over plates coated with mercury, with which free gold readily forms an amalgam. With increasing depth, the ores became more complicated, and the metals were found in combination with one another

INDEPENDENCE

In 1879, Dick Irwin, a prospector who had washed gold in California Gulch, discovered mineral veins between Leadville and Aspen. As it was July 4, he called his claim the Independence. The strike precipitated a rush and started a town that was given the same name as the mine. Other properties were opened up and all did well until water level was reached and the easily treated oxide ores gave way to complex sulphides. Activity virtually ceased 50 years ago, and the once populous place has dwindled to the few structures shown here.

OUT OF THE PAST

The gas street lamp is one of the few remaining evidences of the former opulence of St. Elmo, Colo. When the fixture was erected some 60 years ago it was the last word in equipment of its kind. Below it is shown what is left of an *arrastre* at Buckskin, one of the first gold camps of Colorado. In this circular depression gold ore was crushed by the abrasion of heavy rocks, which were attached to upright supports and dragged around by mule or man power. Some times mercury was added to collect the free gold by amalgamation. *Arrastres* could be constructed with the materials at hand and for that reason were much used when machinery had to be freighted across the plains by ox teams. The case of ore specimens, carrying the dust of years, still stands in the window of a deserted hotel in Pitkin, a camp that was named in honor of F. W. Pitkin, one of Colorado's first governors.

and with various other minerals in the form of sulphides. Stamp mills were of no avail in treating such ores, and smelting had to be resorted to because modern flotation processes were not known. Transportation charges were high, especially so for those camps that had no railroad facilities, and many ores that would not pay shipping charges to smelting points were rich enough to insure profits if they could be treated locally. Consequently, numerous smelting establishments were built in rather remote settings.

As the technique of beneficiation advanced, many variations of existing milling processes also were tried, and sizable sums were spent in providing the necessary plants. Sometimes the mills treated the ore satisfactorily; but in many instances they proved to be unsuitable or could not make sufficient recoveries of the minerals in the ores to show profits. Scores of smelters and hundreds of mills were put up in consequence, and many of them were abandoned. Sometimes rising mining costs stopped ore production, and the treatment plants were shut down or even dismantled. A few years later, renewed mining activity possibly led to the building of new smelters or mills. This cycle was repeated over and over, with the result that some localities have seen smelters constructed and razed as many as three times. This recurring pattern of events accounts for the fact that the traveler may, in several parts of the state, come upon a high brick smokestack rising from an otherwise almost barren tract. Nearby is a slag dump, the size of which indicates the extent of the metallurgical work that was once conducted there.

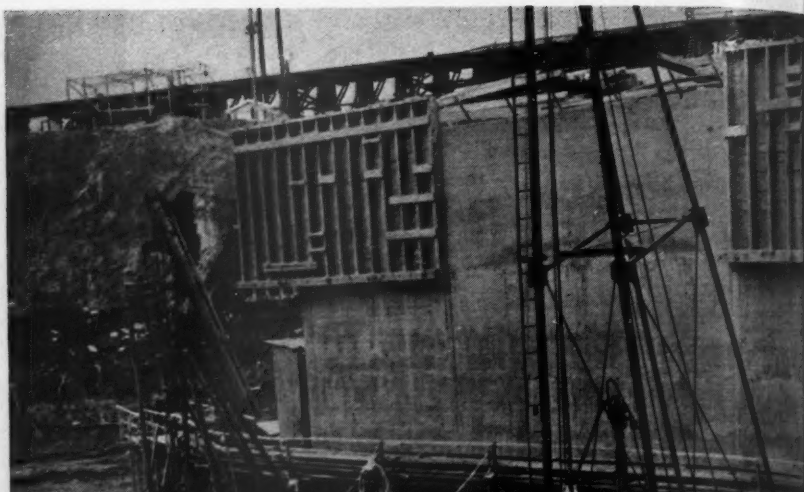
Accompanying illustrations show the stark and stilled remains of a smelter and a mill that were erected at Kokomo, Summit County, a few miles north of Leadville and at the foot of Tennessee Pass. Prospectors were in this area as early as 1860, and some modest fortunes were won from placer operations, both gold and silver being found. J. P. Whitney of Boston opened up lode mines there in 1866 and worked them for several years without profit. The real rush came in 1878, and was an offshoot of the Leadville excitement over lead and silver carbonates.

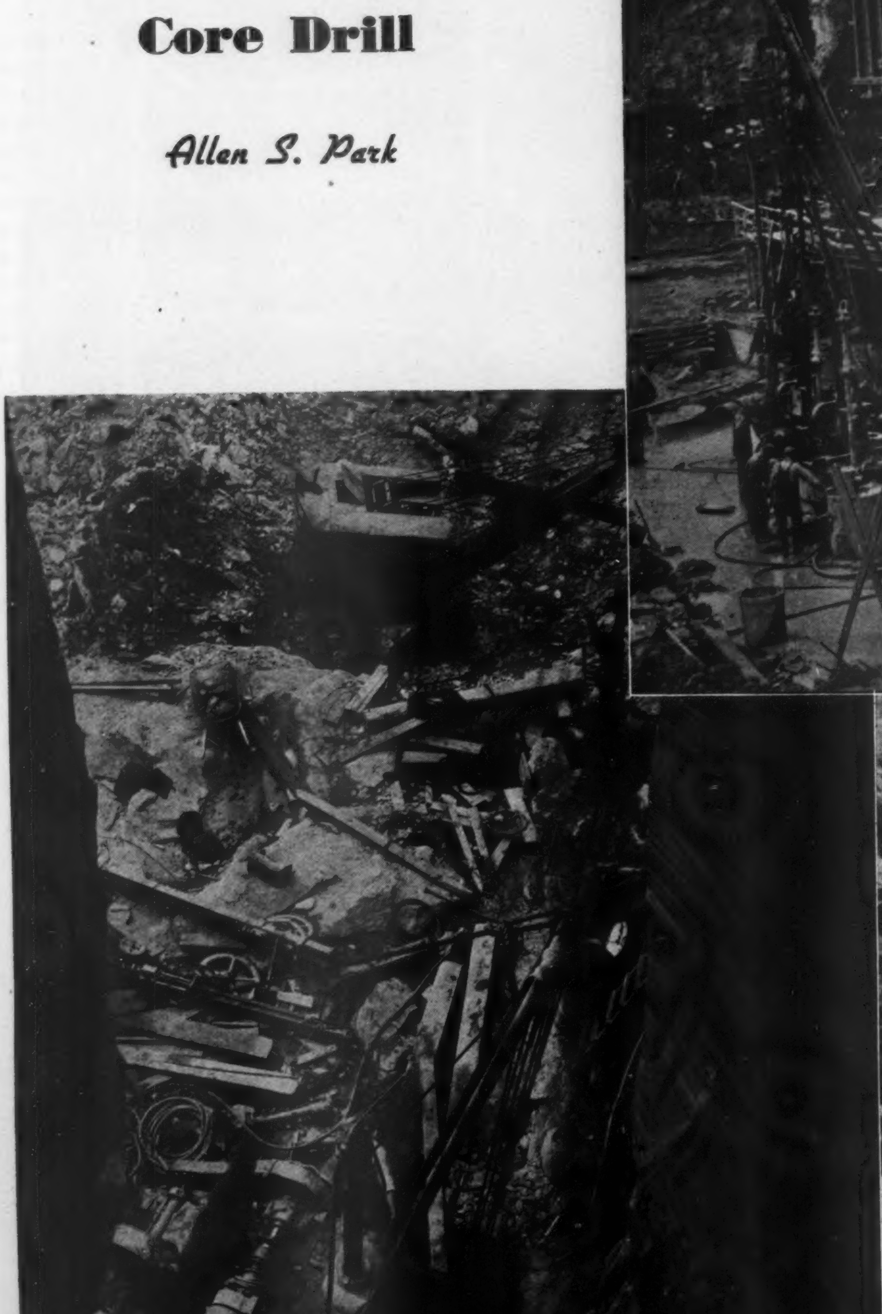
Gold had been produced in the Leadville area for nearly a score of years, the placers of California Gulch having been exceptionally rich. The sluicers had been plagued by a heavy black mineral that lodged in their pans. Some of it had also been encountered in underground mines and consigned to the dumps as worthless. When the true identity of this hitherto unwanted mineral was learned, a boom of great proportions visited the camp. Under the name of Oro City it had dwindled from former opulence to comparative quietude. But with this renascence it again became a beehive of activity.

The town, rechristened Leadville in honor of the newly identified mineral, quickly mushroomed into a city of 15,000 persons and an assessed valuation of $30,000,000. An additional 20,000 persons were living in its environs, most of them searching for more deposits of the carbonates which had swept the new wave of prosperity up to the so-called "Cloud City," perched nearly 2 miles above sea level. Many fortune hunters swarmed over Tennessee Pass to the Tenmile District, found some mineral, and envisioned another great camp. On February 8, 1878, the Town of Kokomo was located. It grew more by reason of hope than production, and two smelters and several mills were erected. The ore proved to be of limited extent, and in a few years the district was almost abandoned.

The Versatile Core Drill

Allen S. Park





DRILLS AT TWO DAMS

Top right, a 48-inch (foreground) and a 36-inch Calyx drill being used at Gilbertsville Dam now under construction by the TVA near the mouth of the Tennessee River. They are boring on the site of a lock wall which will be underpinned with concrete columns to be poured in cored holes extending down to bedrock. The view immediately above shows a cutoff trench at the Prettyboy Dam in Maryland which was excavated between slots cut in the rock by the wire-saw method. Holes for tension posts were put down with 36-inch core drills.

THERE has been a marked increase in the use of core drills in recent years. This is especially true of the larger equipment that can now be had for drilling holes up to 48 inches in diameter. The greater utilization has resulted not only from new applications but also from wider service in long-established fields. Core drills are of two general types: diamond drills and shot drills. The first type is for small-hole work and the second for making borings of larger diameters. In general, each has its distinct field of usefulness, and the two compete with each other only to a very limited extent.

The core drill is the modern counterpart of the tubular drill devised by ancient peoples. The first drilling tool was probably a jagged piece of hard rock such as agate or quartz attached to a round shaft of wood to permit turning it between the hands or by means of a thong wrapped around it. About the time the pyramids were built, or approximately 5,000 years ago, tubes of impure copper were employed for this purpose, using sand or some other abrasive as the cutting medium. The rotating tube cut a circular groove of narrow width, leaving a core that was afterward broken off, and obviously reduced the work involved because only a small part of the cross section of the hole was drilled. This method was used for quarrying rock and for hollowing urns, vases, and similar articles.

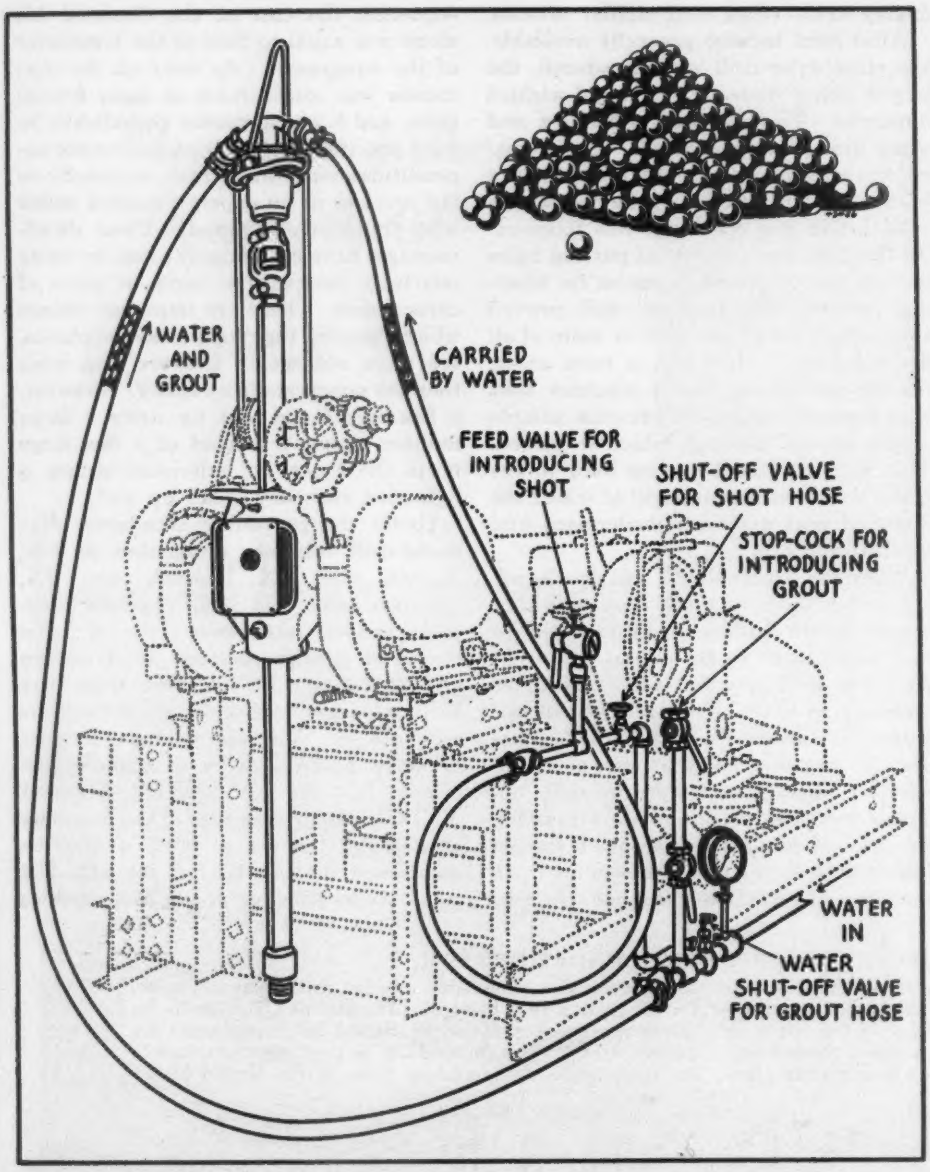
After steel became generally available, the chisel-type drill was introduced, the power being delivered by hand-wielded hammers. This speeded up drilling; and when mechanical rock drills were invented, the same practice of cutting the entire area of the cross section of the hole with a solid bit in one operation was followed. As the principal purpose of putting holes in rock was to provide a recess for blasting powder, this type of drill proved satisfactory for 95 per cent or more of all drilling work. However, a need arose, notably in mining, for a machine that would permit taking an accurate sample of the ground through which it passed. This was achieved by going back to the principle of the tubular drill of which the diamond core drill is a modernized and mechanized form.

When the diamond drill was developed, the carbonadoes or black diamonds that served as the cutting medium could be had for from $3 to $5 a carat. At that price the drill operated with reasonable economy, even though it was the practice to use a few stones that, individually, were of fairly large size and that were occasionally lost when fractured or unusually obdurate rock was encountered. Gradually the price of diamonds rose until it ranged from $90 to $125 a carat, depending upon the size and quality of the stone. In consequence, the cost of the diamond bit alone was equal to that of the remainder of the equipment. As wear on the diamonds was considerable in some formations, and it was necessary periodically to reset the stones in a bit, maintenance expenditures were rather high, especially as the services of an expert diamond setter were frequently required. These disadvantages have been largely offset by using relatively inexpensive borts in place of carbonadoes. These are imperfect stones which, because they have cleavage planes, are more subject to fracture and wear than the noncrystalline variety. However, it has been found that by using a large number of small instead of a few large borts the shock on individual stones is lightened and they stand up well.

Under the prevailing standards, diamond-drill bits are designated as EX, $\frac{7}{8}$-inch core; AX, $1\frac{1}{8}$-inch core; BX, $1\frac{5}{8}$-inch core; and NX, $2\frac{1}{8}$-inch core. The cast-set, round-nose type of bit is the most popular because as it assures greater contact of the bort with the surface being drilled than does the square-nose design. The approximate number of stones in bits made by one manufacturer are: EX, 251; AX, 284; BX, 327; and NX, 468. To give an idea of the economy effected by the use of bort, it may be mentioned that an EX bit set with 251 small stones sells for about $50, whereas

CHECKING NORRIS DAM FOUNDATIONS

The picture at the left, below, shows a 36-inch Calyx drill starting a hole in the limestone bed of the Clinch River, in Tennessee, at the site of Norris Dam, first of the chain of TVA structures. Cores extracted from some of these holes are seen at the lower right. In addition to examining the cores, geologists descended into the drill holes to inspect the foundation rock in place. The use of Calyx drills for this purpose was instituted by Barton M. Jones, chief engineer of TVA. This procedure is now regular practice on most large dam-building jobs in the United States.



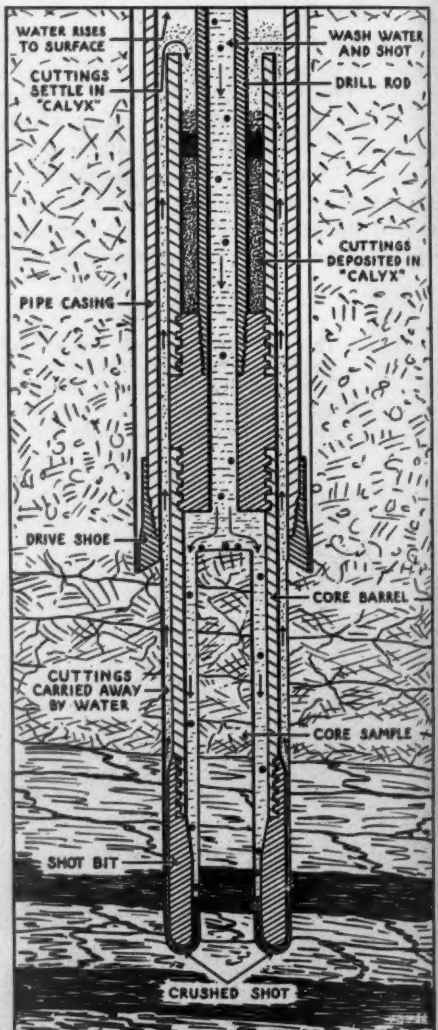
FEEDING SHOT AND GROUT

Calyxite, or chilled shot, consists of granules of steel that are hardened by dropping them in cold water while they are in a molten state. The pieces have an average thickness of about 3/32 inch and are hard enough to scratch glass. Under the pressure of the drill bit they are crushed into angular fragments that grind away the rock surface as the bit is rotated. The shot is fed into the hole through hollow drill rods, to which they are carried by a stream of water. The amount of shot required per foot of hole ranges from 3/4 pound to 4 pounds, depending upon the hardness of the rock. After leaving the drill rods, the shot falls down the annular space between the core and the inside of the bit. The usual method of breaking the core loose from the mother rock is by introducing grout pebbles of quartz or some other hard rock into the hole in the same manner as the shot is fed. A separate hose connection is provided for this purpose. The pebbles, under the pressure of water pumped down the drill rods, wedge between the core and the bit. Rotation is stopped while they are being fed, and when it is resumed, the torsional force exerted on the core breaks it off. Rods, core barrel, and core are then hoisted to the surface and the core is removed.

the same bit set with six or eight carbonadoes costs around $600. The diamond drill has consequently maintained its position, and is superior to any other type for certain classes of work. It possesses the advantage of being able to drill at any angle, and is well-nigh universally employed for underground prospect drilling in mines.

The increase in price of carbonadoes created a demand for a less expensive core-drilling machine, and this was answered by the Davis Calyx core drill invented by Francis H. Davis. Available patent literature reveals that this machine was developed in Australia and brought to the United States by Davis about 1893. In general construction it is similar to the diamond drill in that the power for turning the annular bit is transmitted through the medium of hollow rods. The original Davis bit was a cylinder fitted with forged cutting teeth. This was satisfactory in soft ground, but it could not compete with the diamond drill in hard materials. Around 1900 Davis introduced the use of chilled steel shot. This is fed through hollow rods into the drill hole where, underneath the edge of the cylindrical bit, it is crushed into highly abrasive angular particles that wear away the material being drilled. During World War I it was given the name Calyxite because "chilled shot" implied some connection with munitions.

To exploit his drill, Davis formed the Davis Calyx Drill Company and operated it successfully for several years. It was taken over in 1905 by Ingersoll-Rand Company, which has since then manufactured the drill, improved it, and increased its scope of service. The name Calyx was adopted because the calyx of a flower catches moisture. The calyx of the drill—a hollow, round barrel located above the drill bit—serves a somewhat similar



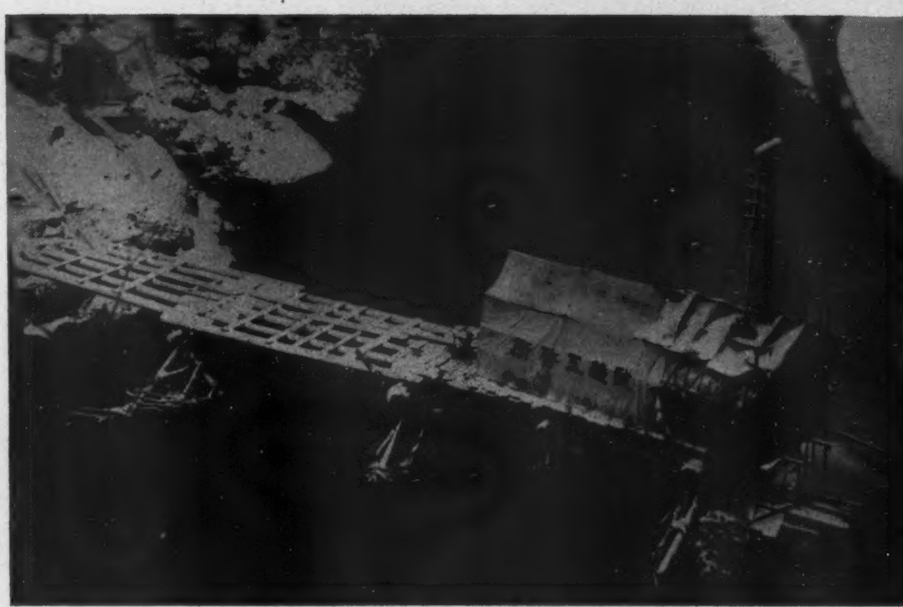
LONGITUDINAL SECTION OF TOOLS IN HOLE

This drawing shows the essential parts of the cutting mechanism of a Calyx shot drill. It illustrates how shot and water are fed down the hole and how cuttings are carried upward and deposited in the calyx. Casing the hole with pipe, as shown here, is not necessary ordinarily.

purpose. Water pumped down through the drill-rotating rods washes the cuttings up through the annular space around the bit. When the flow reaches the top of the calyx its velocity is decreased, causing the sludge to settle in the barrel. The deposited cuttings are a sample, arranged in reverse order, of the material penetrated. This is extracted each time the tools are pulled out of the hole to remove a core section. It serves merely as a check and is seldom required because the core itself is a complete and accurate log of the formation.

The field of the Calyx drill is boring core holes of sizes larger than those made by diamond drills. It will successfully penetrate any material that will stand up under the coring action and that is hard enough to prevent the shot from becoming embedded in it. The smallest Calyx drill makes a $2\frac{1}{2}$-inch hole and takes a core of $1\frac{5}{8}$ inches: the largest model so far built drills a 48-inch hole and takes a core approximately $45\frac{1}{2}$ inches in diameter.

The cost of boring large holes with diamond drills would obviously be prohibitive, whereas with the Calyx drill it is low enough to make the method commercially attractive. In fact, it can put down a 36- or 48-inch hole as reasonably as an opening of equivalent size can be driven by established mining methods. In addition, it can usually complete the work quicker; and in certain operations it possesses several advantages, chiefly that of making a smooth-walled hole without in any way shattering or disturbing the material through which it passes.



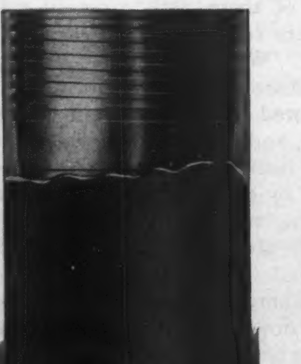
DRILLING IN JAPAN

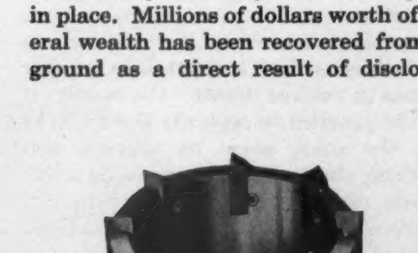
Winter exploratory operations on the bed of a river prior to the construction of a dam by the Mushashi Hydro-electric Company. Calyx drills perform a variety of services in many parts of the world.

Core drills are truly trail blazers in the mining and construction industries. Figuratively speaking, they enable engineers to peer far into the earth's crust, for they extract a continuous sample that reveals the character of the formations penetrated as faithfully as if they were actually seen in place. Millions of dollars worth of mineral wealth has been recovered from the ground as a direct result of disclosures made by core drills. Conversely, millions of dollars that might have been spent in fruitless searches for minerals in barren ground have been saved by coring the areas in advance of development work.

In the construction field, core borings are now considered an essential phase of preliminary engineering investigations in various kinds of work. Today, no good-sized bridge is built without first taking cores to determine the character of the ground on which it is planned to seat piers and abutments. Similar geological investigations of foundations at dam sites are standard practice. Sometimes tunnel drivers avail themselves of coring as a means of foreseeing possible difficulties and as a basis for computing tunneling costs. This was done, for example, in the case of the seven Pennsylvania Turnpike tunnels. These partially driven railroad bores, that had stood untouched for about 60 years, were core drilled to obtain information for estimate purposes and to assist prospective bidders. In the case of the Moffat Railroad Tunnel, which pierces the Continental Divide in Colorado and cost, roughly, three times the estimated figure because it penetrated badly fractured and unstable ground that called for heavy steel supports, valuable advance knowledge could have been gained by taking corings.

Both diamond and shot drills were formerly operated with steam, necessitating the use of cumbersome and heavy boilers. About 1919, rigs driven by gasoline engines or electric motors began to make their appearance, and steam is now seldom employed. This change in motive power, along with weight-reducing refinements in the drilling equipment, has resulted in outfits that can be flown into remote locations, thereby greatly extend-





DAVIS CUTTER AND SHOT BIT

The first Calyx drills did their cutting by means of teeth forged on to the lower edge of a steel cylinder, and this type of bit is still used in soft formations. The latest Davis cutter (right) has removable steel teeth that can be sharpened on an ordinary emery wheel or grinder. Harder materials are drilled with a shot bit (left) that has one or more diagonal slots, as shown. These permit the shot to work under the edge of the bit and also constitute outlets for the water that is pumped down inside the bit to assist in drilling and to wash away cuttings.

EXPLORER DIAMOND DRILL

A 1-man, light-weight, air-driven, column-mounted diamond drill in use underground in prospecting work. The same type of machine can be frame-mounted and driven by a gasoline engine or an electric motor. For holes deeper than 300 feet, a drill of heavier construction and greater power is required.

ing the field of application of core drills and materially reducing the time required to conduct definitely informative prospecting investigations. A gasoline-engine-driven diamond drill that will take a ⅞-inch core to a depth of 300 feet and that weighs only 700 pounds is now available. Completely equipped with drill rods, core barrels, pump, and miscellaneous accessories, it weighs approximately 2,500 pounds. This is well within the load-carrying capacity of lighter-type planes.

Further, flying machines insure quick delivery of supplies and spare parts, to that extent cutting down the initial investment; and they likewise accelerate the transportation of core samples to the outside for analysis or assaying. The reduction in investment is especially marked in the case of bits. A few ready-set cast bits can be sent in with the original equipment, and renewals can be expeditiously transferred by plane, thereby eliminating the tedious task of bit setting on the job. Thus we have another instance of the airplane's part in bringing isolated regions closer to the commercial world, and this is in addition to the advance registered in machinery design.

The most notable expansion in the use of core drills during the past decade or so is attributable to the larger sizes of shot drills. One of the first fields of service for the 36-inch-diameter Calyx drill was in the slate quarries of Pennsylvania, where it was introduced about 1928. The quarrying of slate is inherently wasteful, as much as 75 to 80 per cent of the material excavated being discarded in the area under discussion. Because competitive materials were making great inroads into the industry, the operators were especially interested in anything that would reduce the waste, as this meant more economical production.

Slate is taken from the quarries in sizable blocks that are cut into smaller sections in surface plants. Previously, it was the practice to separate these blocks from the main mass by drilling and broaching channels with percussion drills. Despite the exercise of care, there was considerable shattering of the material on either side of the cuts. To obviate this, it was decided to adopt the wire-saw method that had been in use in Europe for many years. This consists of drawing an endless 3-strand, ¼-inch steel cable across the horizontal face of the slate and feeding the saw with abrasive sand and water to make a vertical cut in the desired plane. In order to carry the cut progressively deeper, it is necessary to provide holes at either end of it in which to place tension posts bearing sheaves over which the wire passes. The sinking of these holes to an average depth of 10 feet by conventional drilling and blasting would have badly shattered the surrounding slate and defeated the very purpose of the sawing procedure. So the Calyx drill was introduced, as this machine makes a smooth-walled cut that leaves the adjacent rock undisturbed. Even the core that is extracted is sound, usable material. Drills of this type are now standard equipment in most Pennsylvania slate quarries, and wire-rope sawing has contributed greatly to more economical production.

As a result of the experience gained in the slate region, the wire saw was instrumental in solving a construction problem. In 1931 the Prettyboy Dam was being built near Baltimore to add to that city's water supply. The plans called for the excavation of a cutoff trench in the foundation rock at the upstream face of the structure. As it was important that the rock be disturbed as little as possible, the contractor was prohibited from using explosives. He considered doing the work with channeling drills; but the topography was such as to make it very difficult to set them up. The wire saw was suggested and resorted to, the necessary shafts for tension posts being put down with 36-inch Calyx core drills. The job was speedily and economically done.

During the same year the Calyx drill rendered timely assistance to the foundation contractor on the New York World-Telegram Building in New York City. This large structure stands on West Street in the downtown section of Manhattan Island. The site was on filled ground and had originally been offshore. The water table was only 6 feet below the surface at high tide, and rock was from 40 to 50 feet down. The plans involved driving 373 tubular piles to solid footing, filling them with concrete, and capping clusters of them with concrete mats to form piers to support the superimposed building. When it came to driving the 18-inch-diameter piles, difficulties were encountered. Some of them struck old cribbing, and others met resistance in the shape of boulders. When it was found impossible to get them through those obstructions, recourse was had to Calyx drills. In some cases 20-inch holes were drilled and the piles placed in them. In others, where piles had been driven all or partway down but contained boulders that could not be blown out with air and water, the rock was drilled with 15-inch bits working inside the piles, which were then successfully cleaned out.

When the Tennessee Valley Authority began the construction of Norris Dam in 1934, its engineers knew that there was a seam of clay in the limestone bedrock that would have to be solidly grouted to prevent water from seeping under the structure. To accomplish this, approximately 10,000 holes were drilled with wagon-mounted drifters to depths of 30 feet throughout the foundation area. These followed a definite pattern, and were put down on 5-foot centers. After a given number had been drilled, a mixture of water and compressed air was injected into various holes, in turn; the soft clay was washed out; and grout was introduced to fill the seam. When the grout had consolidated, 5½-inch holes were drilled on 20-foot centers with Calyx drills. The effectiveness of the grouting was then ob-

served by engineers by means of a periscopic instrument that was lowered into each hole. All told, some 500 Calyx holes were drilled in this work.

It was at Norris Dam, also, that the now well-established practice of drilling large inspection holes in foundations was initiated. Prior to that time, geologists had been satisfied with making their underground studies by examining the cores alone. Because of the seamy character of the strata, however, an even better check was desired in this case; and when it was pointed out that coring with a 36-inch Calyx drill would permit a man to descend into the foundation itself, the method was tried. Holes were put down at various locations, and into these Dr. Charles P. Berkey, the chief geologist, was lowered to make a detailed inspection of the rock conditions.

The procedure proved so satisfactory that it was followed on all the other TVA dams and was soon adopted by dam builders in other sections of the country. This method of subsurface examination was used at Grand Coulee, Fort Peck, Bonneville, Shasta, and Friant dams in the western part of the United States, and is considered regular practice on all dams constructed under the supervision of the U.S. Bureau of Reclamation.

DRILLING HOLES FOR PILING

During the construction of the Golden Gate Bridge in San Francisco Bay, two Calyx drills were used, as shown, to drill holes in the water bed into which piles were driven.

Another important user of Calyx drill holes of large diameter is the mining industry. At two large copper-producing properties in the West, 36- and 48-inch holes have been drilled to provide interlevel communication and ventilation. Openings of this sort can be made more safely by coring than in any other way; and there is an advantage in having smooth walls that do not impede the passage of air. It has been found, likewise, that the cost of coring compares favorably with that of doing the work by other available methods. At one mine, a large Calyx drill hole was put down at the bottom of the shaft and served as a pilot opening for deepening it. The same scheme was followed in 1938 on the Delaware Aqueduct, where one contractor drilled a hole 300 feet deep with an electric-driven Calyx rig. It was then enlarged by ring drilling to a finished cross section of 24x30 feet.

The core drill has long played an important part in the petroleum-producing industry. Many times it is desirable to take a core of an oil-bearing formation, especially for accurately determining its thickness. In some instances, core drills and standard oil-well-drilling equipment have been combined to form a single rig. Cores have been taken from oil wells at depths of as much as 4,500 feet.

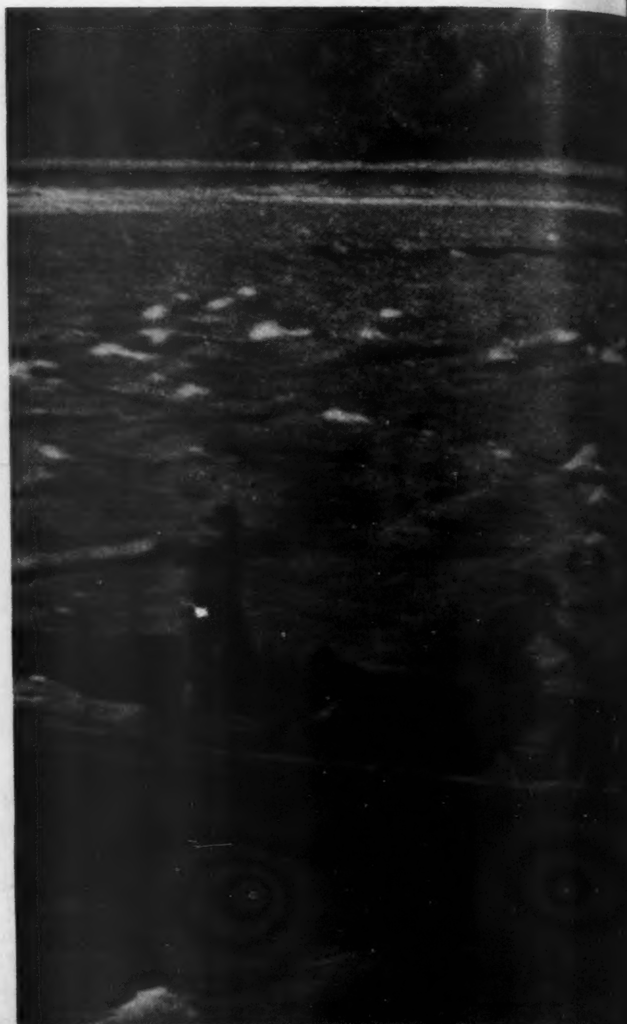
In highway work, Calyx core drills have several important applications. The PT class has been developed especially for pavement testing and is used by the majority of our state highway departments. It is utilized for taking cores of concrete roadways to check their thickness, strength, etc., for contractors are not paid in full for their work until these formalities have been carried out. Some state highway departments mount the drills on small trucks which can travel 50 miles an hour and cover so much ground in a day that the cost per core is very low. In Pennsylvania, which bought its first drill of this type in 1919, as many as 9,000 cores are taken in a year. Small Calyx core drills have also been successfully used to drill holes through pavements for injecting cement-soil mixtures to raise depressed stretches. This is known as the mud-jacking process. The advantage of the Calyx hole over one drilled with a percussion tool is that there is no spalling when the tool breaks through the lower surface.

PAVEMENT-TESTING DRILL

A truck-mounted drill of the Pennsylvania Department of Highways taking a core from a newly laid concrete road to check the contractor's work. Self-contained, portable units also are available for this service. These machines are likewise used to drill holes in roads, sidewalks, and floors for pipes, anchor bolts, etc.

A Northland Expedition

Frank Miller



NORTHLAND SCENES

Above is shown the first automobile to arrive at Fort Chipewyan. It is being drawn by a dog team after having been recovered from Lake Athabasca where it had broken through the ice. In the background is a Catholic mission with children on the porch. At the right is a Peace River grave marker nailed to the side of a store building which was erected over the grave.

Editor's Note: Core drills, which are described in the preceding article, are often used in remote areas. Formerly the transportation of the heavy equipment required was a tremendous job. Following is an account of a trip made in 1915 to Lake Athabasca, Canada, to prospect for nickel.

WHERE extended stays are contemplated in isolated regions far removed from a source of supplies, everything in the way of camp equipment, food, materials, and machinery must be prepared far in advance. Often adverse winter weather may cut a camp off from the outside world for several months at a time. This is especially so in the case of the North country. An example of this kind was a 600-mile trip made 26 years ago to a mining prospect at Fond du Lac on the northeast shore of Lake Athabasca in the Province of Saskatchewan, Canada.

After all supplies for a winter's stay in the North had been purchased in Edmonton, Alta., our party started by train with two 1800-foot Calyx drills, steam boilers, and boring tools for Athabasca Landing, where the journey was continued by water. The season being well advanced, with cold weather not far off, haste was necessary. The Athabasca River was falling, which made the passage down that stream more hazardous in view of its shallows and rapids. Our fleet consisted of scows built locally and for the most part of 2x4 and 1-inch boards. Each was

40 feet long, 8 feet wide at the bottom, and 10 feet wide at the top. With the addition of plenty of oakum and pitch, they were made fairly watertight, and each was provided with a wooden scow pump.

In all, we had nineteen scows among which an approximate load of 100 tons was divided. One was equipped to serve as a cook tent, and another carried food supplies. About a week was required for loading and fitting the boilers into cradles, which were fastened to the bottoms of the boats by means of cables and turnbuckles. Manhole and handhole plates were put in the boilers, and to the firebox was attached a length of ¾-inch wire cable with a buoy at the free end. This precaution was taken so that in case of a wreck we would be able to locate the boilers and have a chance of recovering them. We understood that there were plenty of places in the river which might cause trouble.

During the passage downstream it was necessary to portage the supplies and equipment, except the boilers, around the rapids and falls. The latter were run through with the assistance of poles and ropes. After ten days of drifting with the current, and with the aid of tent flaps and blankets for sails, we arrived at Fort McMurray, one of the principal stopping places between Athabasca Landing and Fort Chipewyan. There we made a general overhaul, pumped out the boats, and recalked many of the seams which had opened up during the strenuous trip through the rapids. At that stage we laid off many of the Indians who had helped us over the stretches where the going was rough. From there on we had quiet water to Fort Chipewyan. Although we had several narrow escapes before entering the lake, we reached that point without the loss of men or equipment.

SHOOTING THE RAPIDS

One of the 40-foot scows being run through the Cascade Rapids in the Athabasca River on the inbound trip. The supplies were first unloaded and portaged around the rapids by Indians. This could not be done, however, in the case of the scows carrying the boilers. To prevent those boats from breaking in two while going over the falls they were run through sidewise.

ON ATHABASCA LAKE

Part of the fleet of scows (right) being towed to the scene of the drilling operations at the eastern end of the lake.

At the fort we spent a number of days reloading some of the material for the journey down the lake, a distance of approximately 170 miles. We left Chipewyan for Fond du Lac with fifteen scows towed by a small steam tug and a launch. At Burnt Island, about 20 miles from Chipewyan, we nearly came to grief in a storm. We tied fire bars and other heavy objects to ropes to form drag anchors to prevent us from going ashore. Three of the boats, which we feared had been lost during the night, did go ashore on another part of the island. About noon the next day five of the men turned up after a touch-and-go experience during which they had had a hard time trying to keep the scows afloat and from being driven out into the lake.

After another general overhaul and patching up the leaky vessels we proceeded down the lake in a snowfall. The weather was beginning to get wintry—ice was forming in the bottoms of the boats freezing the cases fast. At night we anchored in small bays for protection. Our worst experience came one night when a storm blew up and four of the scows drifted ashore. Two of them were a total loss, and everyone was kept busy salvaging the cargoes, for two of the boats contained our food supply for the next six months. It was one grand scramble working waist-deep in ice water for two hours getting everything possible ashore. During that period we pitched tents in the bush and divided the recovered material among the remainder of the scows. We left about 2,000 feet of drill rods above the shore line, marking the spot with a pole set in a cairn so that they could be located the next spring when the lake would be free of ice.

We finally reached our destination 25 miles beyond Fond du Lac, with the weather becoming more forbidding. It was now a race to get the freight unloaded and ourselves under cover before the freeze-up. We found the cases containing parts of the Calyx drills so tightly frozen to the bottoms of the boats that we had to chop up the cases and take the parts out piecemeal. Before doing this we pushed long poles under the scows to form skids upon which we hauled them as far as possible up on the beach. All the materials in the scows were saved for building purposes. One member of the party was kept busy tending a big fire in order to thaw out the lumber and to get it into a usable condition, while the rest of us were occupied moving everything back in the bush where it would be protected from the weather. The scows with the boilers were pulled shoreward until they dragged bottom. Then we sawed out the sides and rolled the boilers up on the beach with ropes and tackle.

During this period we were living in tents with the temperature at times reaching 20° below zero, Fahrenheit. Everyone had to take a hand at construction. The floor of my cabin was the bottom of a scow, and the roof and sides were boards from the hull. The inside was lined with building paper, a supply of which we procured before leaving Edmonton. This was of great help in keeping out the biting winds. After everything had been made as snug as possible, a hunting party shot enough caribou to keep us in meat for the winter. With the ham and bacon we had brought with us, we were well supplied. In addition, the lake furnished us with some of the world's finest fish. Trout weighing up to 25 pounds each were caught in nets lowered through holes in the ice, which was several feet thick. We also had to provide fish for the dog teams, and obtained an abundance of whitefish for the purpose.

During most of the winter months the drill crews were kept busy setting up the machines, and for a time one drill was kept in operation. Difficulties were encountered in keeping a water line open from the lake with a steam ejector. The steam and water lines were wrapped together with moss and anything else suitable that happened to be available. Twice during the season we were visited by members of the Northwest Mounted Police Patrol, and we were always glad to see them and to get news from the outside.

The country we found so inaccessible has now been opened up by air transport, which has reduced the weary weeks of travel to a comfortable few hours. The romance of the old days has passed and the North is being brought closer to our back door. However, there are still vast sections of the Canadian Northwest that have never been trodden by man, so who is to say what remains there to be discovered. A successful strike spells satisfaction; and no greater thrill can be experienced by a prospector than that of uncovering a rich deposit of mineral. A dollar in the raw has far more glamour than all the nice new bills passed through the teller's window. This may sound like romancing; but anyone who has been beyond the beaten trail will understand.

A DRILL AT WORK

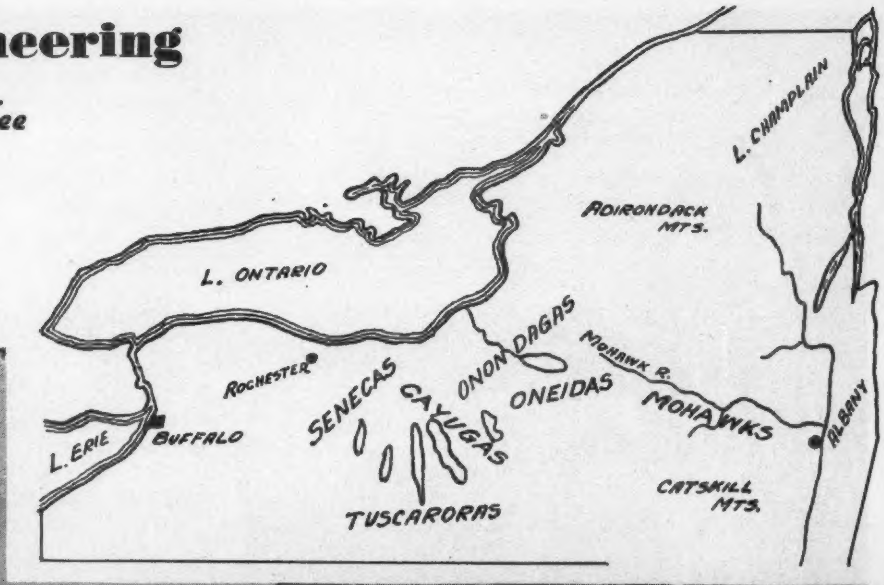
Despite severe cold and heavy snows, one Calyx drill was set up and kept in operation most of the winter. The other rig was assembled in spring, when both outfits were used until the work was completed.

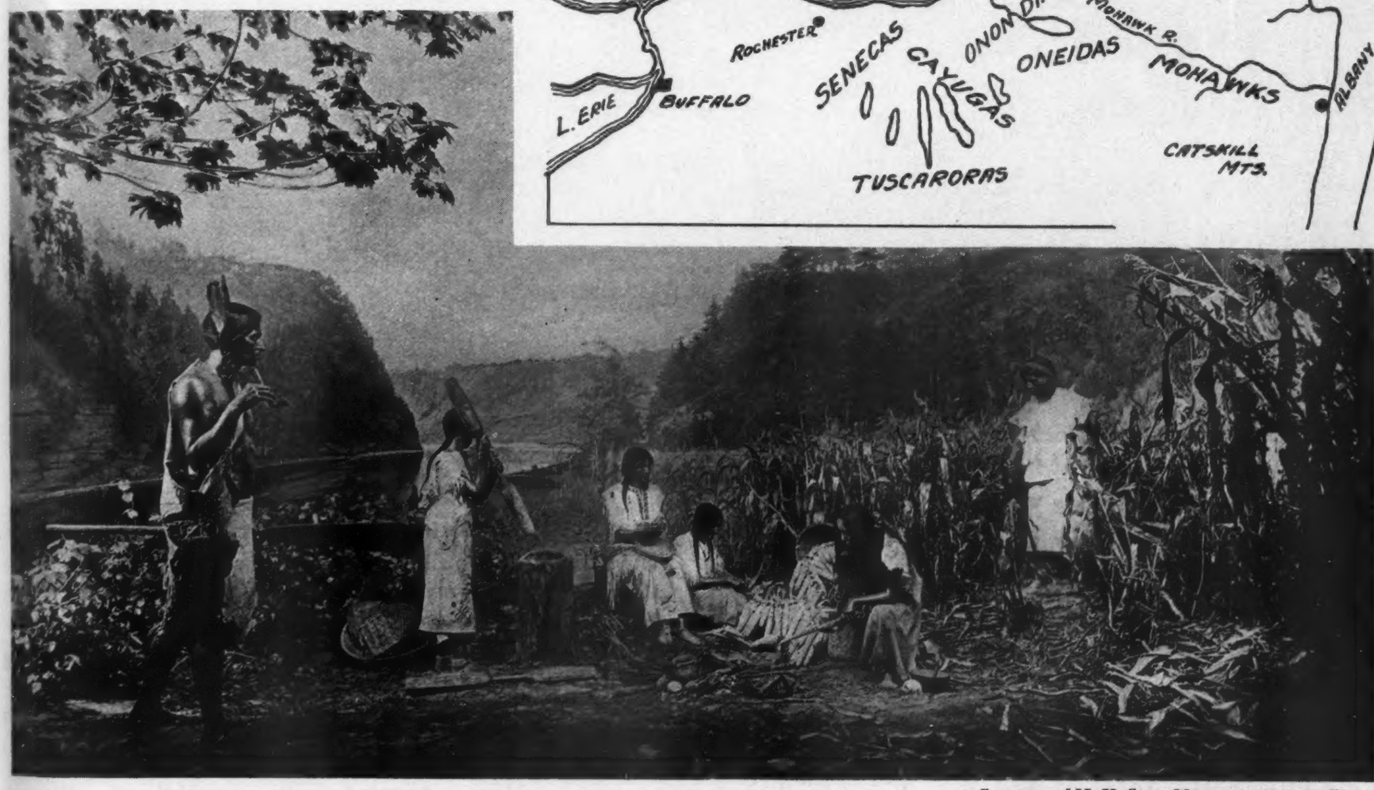
FISHING THROUGH ICE

During the winter, the ice on the lake reached a thickness of 6 feet. Through holes cut into it, lake trout weighing up to 25 pounds each were caught in nets, as well as whitefish for feeding the dog teams.

Iroquois Engineering

Roy E. McFee





Courtesy of N. Y. State Museum and J. A. Glenn

THE CORN HARVEST

Maize, beans, squashes, and other garden crops were extensively cultivated by the Iroquois and represented a large proportion of their food supply. Companies of women in each village did the planting and harvesting. The men cleared the land and furnished the meat, but seldom worked in the fields. This picture shows a harvest scene in the Genesee Valley. The women are pounding corn for meal, shelling beans, braiding corn, baking corn bread, and gathering corn. The man has just come from his canoe, in time for lunch. The Indians are all Senecas. This photograph and the others reproduced with this article show all but one of the six dioramas of Indian life in the New York State Museum at Albany. The figures are life casts of the best types available. The background paintings are each 55 feet long. The map indicates where the six Iroquois tribes lived in the State of New York.

THE structural works of the American Indian furnish us with one of the best measures of his ability and culture, and among the picturesque enterprises of the red man north of the Rio Grande those of the Iroquois were the most notable and significant. The latter are best known to history as the Iroquois Confederacy, or Six Nations, which the first colonists found occupying central and western New York. Of the six tribes composing the Confederacy the Mohawks were located farthest east, inhabiting the Mohawk Valley. The others, in their order westward, were: the Oneidas, the Onondagas, the Cayugas, and the Senecas in the vicinity of Rochester. Latecomers into the league were the Tuscaroras who settled near the Finger Lakes.

Situated as they were on strategic ground, the Iroquois could hardly fail to achieve something in the building line. They were settled astride one of the most important transportation routes in America—the Mohawk Valley—the only water-level pass through the Appalachian Mountains north of Georgia. It had been a much contested pass; and in the days of the red man the Mohawks were the first permanent owners because they alone were strong enough to seize possession of it and hold it against all rivals. Besides, the Iroquois were favorably located for striking against the lands of distant tribes. The region inhabited by them was close to the headwaters of tributaries of great river systems, and it was possible by means of short portages to reach the St. Lawrence, the Hudson, the Susquehanna, the Delaware and the Ohio rivers, as well as the Great Lakes. It was the use of some of these same water levels later on by the white race that led to the creation of the present New York State Barge Canal.

But in addition to being fortunately situated, the Iroquois were on a higher plane mentally than other tribes. The historian Parkman describes the Iroquois family of Indians as being an island of high intelligence surrounded by a huge sea of Algonquin mediocrity. It is not surprising therefore that their construction projects were far superior to those of their neighbors. Of course, viewed in the light of their opportunities, their achievements do not loom large. Like all members of their unchanging race, they looked only to their immediate needs.

One of the first considerations of all peoples is the matter of shelter. As might

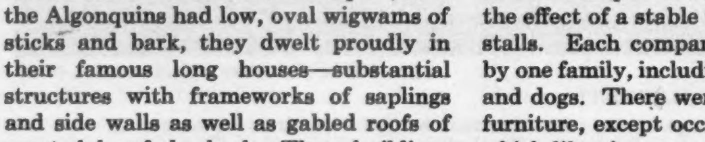
Courtesy of N. Y. State Museum and J. A. Glenn

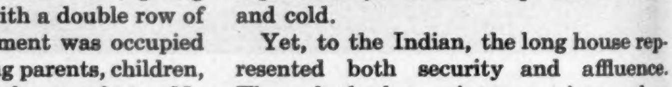
RETURN OF WARRIORS

The advance party of a Mohawk war expedition to Skanehtade (Albany) upon its return to the Mohawk capital, Theonondiogo (Two Noses), with two Mahikan prisoners. The one at the left has thrown down his burden in defiance and is about to be set upon by his captor when a woman chief of the village saves his life by holding up a ransom of white wampum. At the right is a Mohawk war chief in full regalia with his prisoner. The Indian in the background is calling other warriors to the hilltop for a council. At the extreme right is a section of a vertical log stockade.

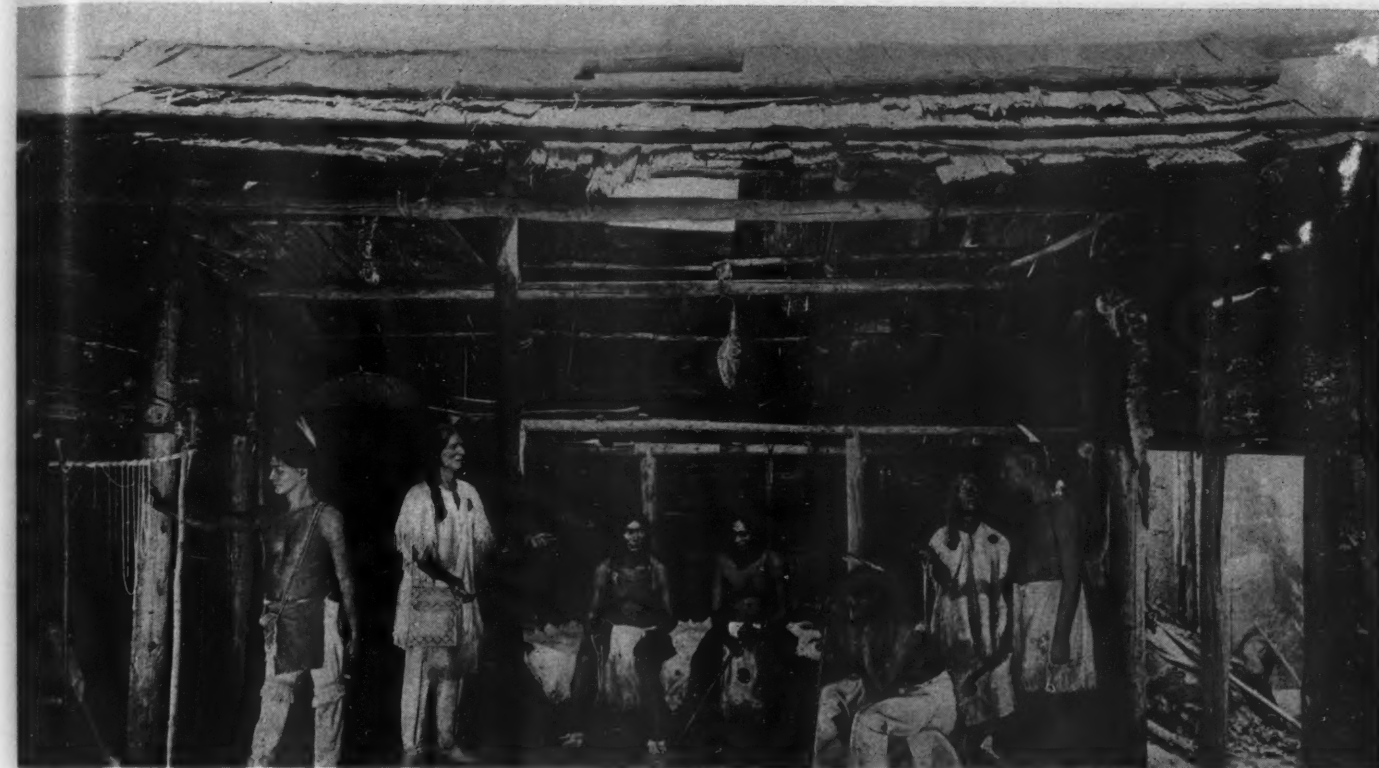
be expected, the Iroquois had a comparatively high type of habitation. While the western Indians lived in skin tepees, and the Algonquins had low, oval wigwams of sticks and bark, they dwelt proudly in their famous long houses—substantial structures with frameworks of saplings and side walls as well as gabled roofs of great slabs of elm bark. These buildings were truly long houses. Although only about 15 feet wide and one story high, they ranged in length from 100 to as much as 500 feet, in unusual cases. The entrance was at one end and gave access to a central aisle that led to a storeroom at the other end. Partitions of bark subdivided the spaces alongside into small compartments that were open toward the aisle, giving the effect of a stable with a double row of stalls. Each compartment was occupied by one family, including parents, children, and dogs. There were few comforts. No furniture, except occasional rude benches which likewise served as beds. The floor was the natural earth, covered with leaves, dried grass, and some skins. Each family had its own fire for cooking and heating, a hole in the roof directly overhead permitting the smoke to escape. There were of course no windows, the only light coming from the fire or through the opening in the roof or cracks in the walls; and nothing but a layer of bark kept out the rain and cold.

Yet, to the Indian, the long house represented both security and affluence. Through the long winter evenings, when storms raged and wolves howled in the forest, the motley population lived an intimate community life. Warriors visited from fire to fire, women gathered in groups, and children and dogs raced the length of the house. This sense of well-being was heightened by the fact that as many as 300 bushels of corn sometimes filled the





SECTION OF LONG HOUSE AND LAYOUT OF VILLAGE



Courtesy of N. Y. State Museum and J. A. Glenn

COUNCIL OF THE TURTLE CLAN

Here the Turtle Clan chiefs of the Onondagas are discussing some important tribal subject within the private bark lodge of their fire keeper. Second from the left is the presiding chief, who must give the decision. The chief woman of the clan, near the right, asks her secretary, a young man, to protest a contemplated action by the council. The seated figures are sachems. The man at the left records the proceedings by means of wampum strings. All the furnishings of the lodge are of Indian make and typical of early times in an Onondaga village.

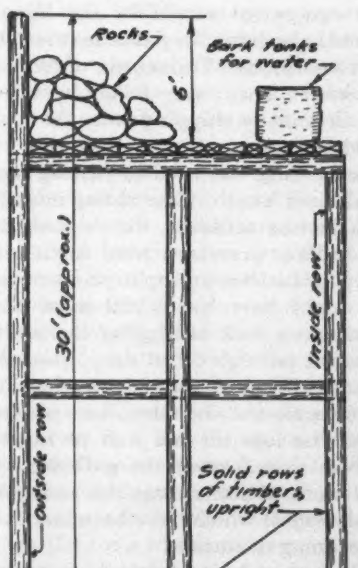
storeroom, and dried fruit and smoked meat hung from the rafters. With the larder full, and sheltered from the elements, the dwellers could confidently await the spring and sunshine.

The long houses were not built separately at isolated spots in the woods, but were grouped, forming protected villages numbering in individual cases as many as 50 buildings. Generally, they were scattered along both banks of the Mohawk River for a distance of 20 miles and apparently were rarely deserted, and then only because of the fortunes of war. It is believed that the Mohawks, during their entire occupancy of the valley, had five successive sets of villages, the sites of most of which are known to historians. The settlements were invariably located on high ground having three steep or even craggy sides and a level summit covering several acres. Altitudes of 200 feet and more were not uncommon, and it is known that the mountain called "The Nose," which towers 940 feet above the Mohawk River at a point 3 miles east of Canajoharie, was once the site of an early Mohawk village.

The Iroquois always fortified their communities, and so that an approaching enemy could be sighted from afar, each site, including the slopes, was cleared of timber. During their early years in the valley, before 1600, they surrounded themselves with earthworks thrown up on tops of the hills. These were in the form of a square, while those of the Algonquins were circular, the square representing an advanced stage in primitive art and design. This form of protection was soon abandoned by the Iroquois in New York for a remarkable system of timber palisades. The trees cut in clearing the land were set upright to form solid walls inclosing the whole village. The logs were sunk deep in the earth and rose to a height of as much as 30 feet above ground level. Multiple rows were built, sometimes as many as five concentric walls encircling the shoulder of the hill. The outermost row was about 6 feet higher than the inner ones upon which rested a continuous gallery that was reached from within by crude ladders.

Standing on the platform behind the shelter of the outer wall, the warriors could defend their community. In addition to the regular method of warfare—arrows—they used stones. These were piled a convenient distance apart on the gallery and hurled down on the enemy. On it were also placed tanks made of elm bark sealed with pitch to make them tight. These were kept filled with water during an attack to put out fires started by the besieging parties. In a way, the tanks really constituted an automatic sprinkler system, for when they burned they released the water, just as heat now causes it to flow.

With only the most primitive construc-



SECTION OF PALISADE

This shows the construction of a multiple-wall stockade for the protection of a village. On the gallery were placed piles of rocks, ready to be thrown down upon attackers, and tanks of water for putting out fires started by the enemy.

Courtesy of N. Y. State Museum and J. A. Glenn

TYPICAL IROQUOIS INDUSTRIES

Oneida Indians at work in a sheltered spot in their capital village on Nichols Pond, Madison County, which was unsuccessfully stormed by Champlain in 1615. At the left are a basket maker and a belt weaver: at the right are a wood carver, a moccasin maker, and a potter. Each Iroquois had an occupation and was of necessity industrious. Although he appeared taciturn to strangers, the Iroquois was genial among his own people and full of humor.

tion equipment available, the labor involved in building the palisades must have been enormous. Thousands of trees were required. They were felled by burning and alternately chipping away the charred wood by means of stone hatchets. The same method was used in cutting logs to the desired length. Excavating must have been just as toilsome, for the only tools the Indians possessed were turtle shells, sharpened sticks, and split pieces of wood. No doubt bare hands did most of the tremendous task of digging the multiple trenches, perhaps 6 feet deep, around the villages. When it came to actual erecting, strong arms and shoulders were needed to stand the logs on end and to raise the timbers that formed the galleries. The final work of course was the assembling, the details of which have been lost in the intervening centuries.

When the job was finished, an imposing fortification frowned down from the hilltop, one that only a stout-hearted enemy would have thought of attacking. The first settlers referred to it as a castle, probably because it looked as invulnerable as an Old World castle of masonry. Both the English and Dutch colonists in New York paid the Iroquois the compliment of copying their defense structures, for many a frontier fort and individual home were surrounded by massive timber palisades.

A vital feature of each Iroquois village was the outside storage pit for corn and vegetables. It was built on a ridge for purposes of drainage, and its walls of split timbers were topped with a peaked roof of bark, all serving as a protection against storms and wild animals. In it was deposited part of the harvest in individual baskets of bark packed round about with charcoal for the absorption of moisture.

The New York State Museum at Albany has some splendid exhibits in the Education Building portraying the home life of the Iroquois. Life-size figures in actual surroundings show the Iroquois family engaged in its various domestic activities and typical household industries such as pottery molding, wood carving, basket and moccasin making, and weaving. In addition to these, the Indians engaged in such essential tasks as fashioning weapons and tools. The larger ones, including arrowheads, spearheads, knives, scrapers, and hatchets, were of flint laboriously chipped to the desired shape. It is to be noted that the hatchets of the Iroquois were without grooves, as distinguished from those of their neighbors, the Algonquins. Implements like harpoons, awls, needles, and fishhooks were made of bone, and wood furnished bows, the shafts of arrows and spears, and mortars and pestles for the daily grinding of corn. Being fishermen as well as hunters the Iroquois also provided themselves with nets for use in creeks and rivers. As a further aid in catching fish they constructed occasional weirs in shallow waters, thus resorting to a simple form of hydraulic engineering.

But highly colorful in the life of the red man was his means of travel. The Iroquois ranged far on missions of peace and war, and consequently developed certain transportation facilities. Most important were the water routes—the rivers and tributary creeks and lakes. So they built dugouts and canoes. The dugouts, as the name implies, were logs hollowed out by fire and scrapers, while the canoes were ungainly but substantial craft constructed of elm bark. Incidentally, the graceful Indian canoe of white birch, so celebrated in American history and romance, was not Iroquois but Algonquin. By using both canoes and dugouts on the larger streams, and canoes alone where portages had to be negotiated, the Indians could travel fairly quickly. But much of the time they had to journey overland on foot, with only snowshoes and backframes to make the going easier at certain seasons of the year.

The Iroquois had an elaborate system of trails throughout their extensive holdings. Indeed, there is hardly a section in the erstwhile country of the Six Nations where present inhabitants cannot point to what was once an Indian trail. The paths led from village to village, along the banks of streams and through the deep woods. The network reached eastward into New England, northward to Lake Champlain, and southward to the Delawares. But the main trail extended from

Courtesy of N. Y. State Museum and J. A. Glenn

SENECA HUNTERS

A Seneca family gathered about the dooryard of its hunting lodge, each engaged in his or her allotted work. The father, who no longer goes to war, is bringing in a fawn; the mother is skiving a deer skin; and the daughter is cutting strips of venison for "jerking." The elder son, a hunter, is posing with bow and arrow, while the younger son, at the right, is burning and chopping down a tree. Note the clay that confines the flames to the lower part of the tree.

the banks of the Hudson River westward past the Mohawk castles and across the lands of the western tribes to the shore of Lake Erie—it traversed the whole empire of the Iroquois Confederacy from the present city of Albany to Buffalo. Today it is a modern highway route and is still known as the "Iroquois Trail."

For our knowledge of the activities and structures of the Iroquois, we have only to avail ourselves of the detailed reports and descriptions written by early explorers and historians and visit the regions they inhabited. Numerous evidences of their works are visible there and, what is more, these landmarks are in agreement with the records. Remains of the square earthworks can be seen in several places, and at the sites of the villages that overlooked the waters of the Mohawk River it is possible to trace the earth embankments that once were piled along the palisades. Evidences of corn pits are left at Oak Hill, and where ancient Garoga stood are pits from which clay for pottery was taken.

The Iroquois never were mound builders. They left behind no rounded hillocks under towering forest trees. The imagination therefore cannot bring to mind pictures of primitive funeral processions and colorful assemblages at monuments to the departed. But here and there where a slope rises steeply from the shadows of a ravine, slaty steps will be found leading to the hilltop where a group of long houses used to stand. These steps have been worn smooth, and often 4 and 6 inches deep, by the moccasined feet of countless Indians.

For an intimate insight into the Iroquois manner of living, there are the accumulations of ashes, bones, and other debris that are occasionally uncovered to this day at Indian sites. The refuse probably was thrown between the long houses until the piles became so large that they were in the way. Then the waste was carried outside of the palisades and dumped down the steepest slope. After long occupancy, the midden heap of a settlement must have been a sizable one. During the centuries that have elapsed since then they have been hidden by earth and trees; but anyone who cares to dig along such a hillside may find impressive evidence of the life that once existed there.

In search for Indian artifacts, extensive excavations have been made, especially at the Village of Garoga, which was built by the Mohawks in 1595 and had but a comparatively short existence. Trenches dug there have revealed blackened earth, burned stones, ashes, charcoal, and clamshells, as well as pieces of bone and pottery. Arrowheads, harpoons, needles, awls, and jewelry also have come to light to tell something of the story of the aboriginal inhabitants. The Mohawks have been gone from there for nearly 300 years; but the remains are as unmistakable as if they had left only yesterday.

Outstanding among Indians as the Iroquois undoubtedly were, and even though they held sovereign possession for centuries of most of what is now New York State, nevertheless they attempted no permanent improvement of the land. They apparently constructed no bridges except possibly the most temporary of log spans to serve as a crossing along a trail. They had no land routes worthy of being considered roads, which may be explained by the fact that they had no wheeled vehicles and rarely fashioned sleds. With all their excavating, they never dug a canal or built a sheltered anchorage; and there is no proof that they had flatboats or rafts.

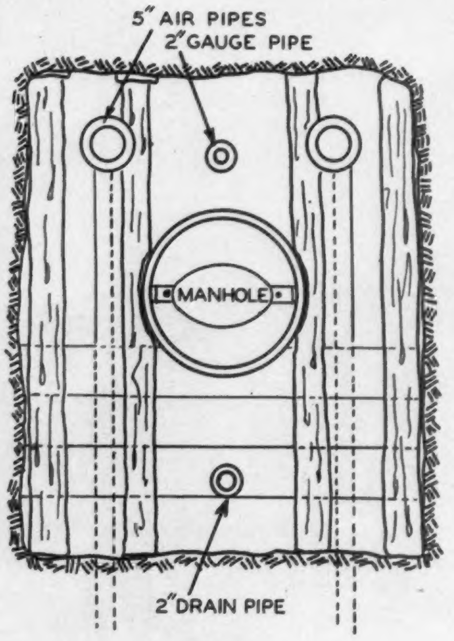
Nationalism kept the Iroquois riveted to their traditions and prejudices. In this connection it is significant to note that their captives were stripped of all non-Iroquois clothing and weapons before they were taken into the tribe. They were slow to try the tools of the white man in their early contacts with explorers and traders; and even the ax, when finally accepted, was used for war purposes only. So it happened that when the Iroquois eventually had to yield ground to the colonists, they left behind no monuments, only traces of their structures and habitations. They had gone on a rampage during the Revolutionary War; and when the conflict ended, the New York State government resolved to march its home-coming militia into their country. But the Indians were forewarned. They loaded their canoes, took leave of their forest empire, and went to Canada.

Rock-Hewn Air Receiver Deep Underground

AN AIR receiver deep underground in natural rock is something of a novelty and is in use in the Tebekwe Mine, Selukwe, Southern Rhodesia, by the Homestake Gold Mining Company, Ltd. The property has been worked intermittently—for years on an extensive scale—since 1890, and in 1935 was acquired by the present management. After unwatering the mine and putting it in operating condition, it was decided further to develop the property; and to do this with the existing compressor capacity the company resorted to the expedient of converting a dead-end drift into an air receiver by blocking it off with a concrete bulkhead.

The receiver is situated on the sixth level 747 feet below the shaft collar and 872 feet below the compressor plant, which is within 100 feet of the shaft. It is approximately 1,150 feet in extent, has a cross section of 40 square feet, and a capacity of around 46,000 cubic feet. To firmly anchor the bulkhead in the drift, the floor at that point was excavated to a depth of 15 feet, and a keyway, measuring 4x2½ feet, was cut in the side walls and roof. The latter work was done with the aid of a hand-held drill, short holes and light charges being used to prevent undue rupturing of the rock formation.

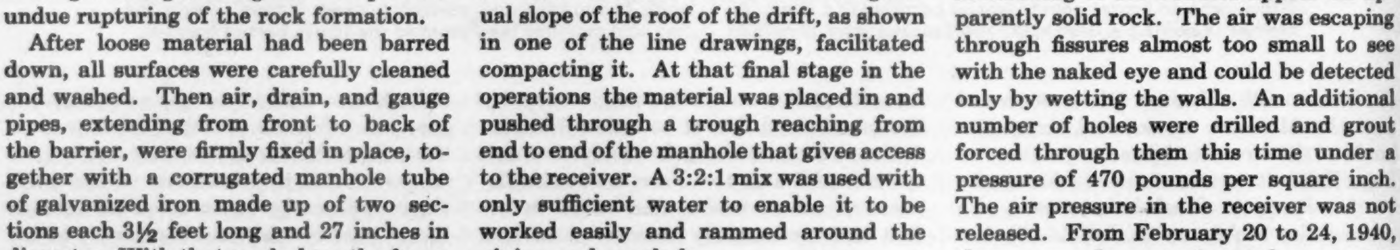
After loose material had been barred down, all surfaces were carefully cleaned and washed. Then air, drain, and gauge pipes, extending from front to back of the barrier, were firmly fixed in place, together with a corrugated manhole tube of galvanized iron made up of two sections each 3½ feet long and 27 inches in diameter. With that work done the forms were partly set up. These consisted of planks nailed to round timbers hitched and wedged into the floor and roof of the drift. The concrete was first poured from the outside of the bulkhead and then from within the structure where the more gradual slope of the roof of the drift, as shown in one of the line drawings, facilitated compacting it. At that final stage in the operations the material was placed in and pushed through a trough reaching from end to end of the manhole that gives access to the receiver. A 3:2:1 mix was used with only sufficient water to enable it to be worked easily and rammed around the piping and manhole.



FRONT ELEVATION

The receiver was first charged six weeks after it was completed. Several leaks were found, and as most of them were in the floor, another 5 feet was removed from the bottom both inside and outside of the bulkhead and eighteen holes drilled into the structure from both directions to break contact between the concrete and walls of the drift. Pipes, ¾ inch in diameter, were inserted in the holes, and then the entire area was grouted under a pressure of 250 pounds per square inch The side walls and roof of the receiver to a point 3 feet back of the barrier were treated in a similar manner.

"The second charging," to quote Mr. Charles Pengilly, manager of the Tebekwe Mine, "was a success and fully justified the additional time and trouble taken. After running the compressors for 5½ hours, the pressure at the receiver underground was 77 pounds per square inch. During charging a few small leaks were heard, one of which was on the floor some 10 feet from the bulkhead. At 3 p.m. the main stop valve was closed and the compressors shut down. At 8.50 a.m. the next day the receiver pressure was 74 pounds per square inch gauge, representing a drop of 3 pounds in 17 hours and 40 minutes. To ascertain the position of the leaks the drift was sprayed with water, and it was astonishing to see bubbles appear on apparently solid rock. The air was escaping through fissures almost too small to see with the naked eye and could be detected only by wetting the walls. An additional number of holes were drilled and grout forced through them this time under a pressure of 470 pounds per square inch. The air pressure in the receiver was not released. From February 20 to 24, 1940, the pressure drop was 4 pounds per square inch per day." This is equivalent to a leakage of only 8.7 cubic feet of free air per minute.



Drawings courtesy The Iron and Coal Trades Review

PLAN AND ELEVATION OF CONCRETE BULKHEAD FOR ROCK AIR RECEIVER

Workers' Trailer Camps

ONE of the results of the quickening of the national defense program is the great tax on housing facilities in areas proximate to large industrial centers. This is especially true of the northeastern part of the United States where plant employee rolls have risen sharply. In certain New England sections the overflow is living in cottages at nearby beach resorts that are ordinarily occupied only during the vacation period. Because of this influx of defense labor, some seaside towns will have no accommodations for summer visitors this year other than hotel rooms.

Despite the great increase in home building, there is a shortage of dwelling places in many localities. There is a limit to the extent private capital will go in putting up additional houses, as it is realized that the defense boom in population may be short-lived. Consequently, it has become necessary for the Government to finance extensive building programs. However, even Uncle Sam isn't happy over the prospect of having a lot of vacant houses left on his hands, and he has therefore turned to the expedient of providing temporary quarters.

One solution of the housing problem has been found in auto-trailer camps of unprecedented size. At Erie, Pa., where the General Electric Company has a large plant, the Government dedicated last month a camp of 200 trailers that cost $400,000. The trailer-home idea has been popular for some time with workers on isolated construction projects; but it remained for the present emergency to apply it on a wholesale scale. Trailers offer several advantages in cases of this kind, the most important of which are low cost, availability, and portability. The last-mentioned feature permits them to be moved quickly when one job is finished and the concentration of workers has to shift to a new location.

Reports from the Erie camp reveal that the trailer occupants are happily ensconsed. The kitchen end of each one contains a cooking range, icebox, sink, plenty of cupboard space, and a table with upholstered benches. The living quarters are at the opposite end and include a full-width bed that becomes a davenport by day. The trailers have been connected with a sewerage system, and roadways through the camp have been graded and graveled. Utility houses strategically located throughout the grounds provide laundry and bathing facilities. The camp is situated within easy walking distance of the General Electric factory.

●

Safety on the Rand

FATAL accidents in the mines of South Africa are only 32 per cent as numerous as they were in 1909, and the accident fatality rate is showing a steady decline from year to year. This encouraging record is attributable, primarily, to the activities of the Prevention of Accidents Committee, and is striking evidence of the fact that intelligently directed safety programs are effective. In 1909, the death rate for Europeans and natives in the Witwatersrand gold mines was 5.26 per 1,000 employees. When the committee began its work in 1913 it was 3.81 per 1,000. In 1940 it was only 1.71 per 1,000, a new low mark.

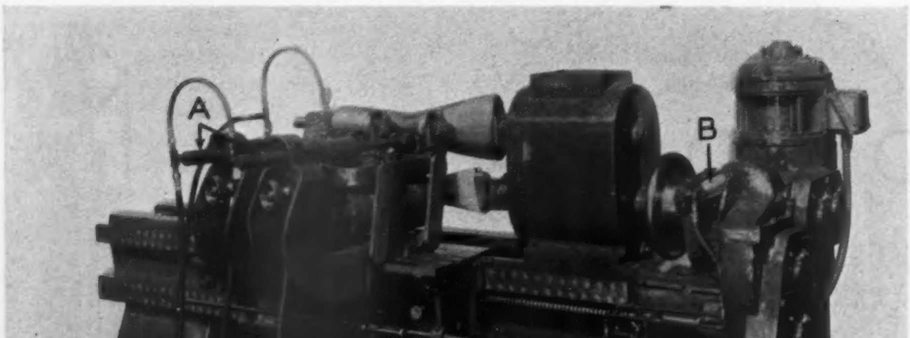
The organization, which has 35 members and obtains its funds from the Rand Mutual Assurance Company, Ltd., conducts its work chiefly through campaigns of an educational nature. Its field is a huge one, for there are 52,000 Europeans and 420,000 natives employed in the gold and coal mines of the Witwatersrand. Of these, 48,000 Europeans and 370,000 natives are identified with the gold mines. The latter are continually growing deeper, which adds to the difficulties and hazards; and the great expansion in production in recent years has complicated the problem of safety by bringing into the workings many men who have had no previous underground experience.

The safety work is on a well-organized basis. Nearly every native compound is equipped with broadcasting apparatus, and daily programs always include talks on safety. Great use is also made of printed material, which is displayed on bulletin boards in compounds, at shaft heads, in pay offices, and at other points where large groups of natives congregate. Last year, 30,000 bulletins were distributed. Nearly 11,000,000 safety notices were also printed and sent to the African Explosives & Industries for inclusion in all cases of explosives to be issued to the mines during the next four years. In addition, the gospel of safety is spread by means of motion pictures and phonograph records.

Instruction in first aid is given to all who are interested, and the natives display an eagerness to enroll. Last year, 29,037 of them completed the course, a record number for one year. Classes are held at a station built especially for the purpose in Johannesburg and equipped with modern apparatus for rescue work and training. All underground officials and some of those on the surface have to be proficient in first aid. Every mine has at least one trained rescue team, and elimination contests are staged annually. Since 1915, three intermine safety competitions have been run, with trophies awarded to the winning mines and prizes to the underground officials of the properties. These contests have promoted safety consciousness among the workers and have had much to do with cutting down the accident frequency rate.

The committee carries on its work through subcommittees. Among these is a technical group which serves as a clearing house for all new safety devices and ideas. These are carefully considered, and the devices that show promise are put to use on an experimental basis. If they prove satisfactory, then they are introduced.

New Lathe Features Air Control



TURNING LATHE
Back view of the new Onsrud machine that was developed primarily to produce gun stocks. The feed of the motor-driven cutters and the rotation of the pattern and work spindles are controlled by pneumatic cylinders *A* and *B*, respectively. Air at 100 pounds line pressure is used; and should the pressure drop or the supply fail at any time, a low-pressure switch will cut out all the motors and stop the lathe. Note the oversize gun-stock pattern on the front of the machine and the butt end of the roughly sawed-out blank beneath it.

FROM blank to finished part in a single pass, that's how Garand gun stocks are turned on the new Onsrud multiple-spindle copy lathe. The machine features a number of small end mill cutters mounted in high-speed heads with an in-and-out motion controlled by pneumatic cylinders. Each head is actuated independently by a guide roller that follows the pattern located above the blank and is embodied in a carriage traveling parallel with the work. The cutters vary in diameter from ½ to 2½ inches and are angled toward the blank at approximately 10°. Each is driven by a 2.66-hp. motor, makes 14,400 rpm., and its rate of feed can be changed to produce a fine, medium, or coarse pitch of cut.

With the blank and pattern in place, the operator sets the machine in motion, and from that time on it functions automatically. By shifting a rod he actuates a valve-controlled air cylinder which, through the medium of two clutches, causes the work and pattern spindles to rotate in unison, simultaneously engaging the guide roller of each of the several heads with the pattern. When the carriage has traveled a predetermined distance, the part is finished; the cutters are retracted and rapidly returned to the starting position; and the spindles are stopped for reloading. The pattern is copied with exceptional fidelity, it is claimed, even to the smallest indentures, and the product is so smooth when it comes off the lathe that it requires only final sanding. The machine is suitable for turning a wide range of irregular shapes such as shoe lasts, golf-stick heads, ax handles, etc., in wood, nonferrous metals, and plastics.

Iceless Ice

MOST of us have heard of dry ice and have probably carried home a carton of ice cream packed in this solidified carbon dioxide to keep it frozen. But hot ice, so called because it reaches a temperature of as much as 78°F., is another matter. It is not a refrigerant, but otherwise has the characteristics of real ice and is being used in place of it in indoor skating rinks. Mark ice, as it is named after its inventor, John Markman, is a mineral product that is applied in liquid form. It sets almost immediately after spraying, it is claimed, making it popular with hotels where ice-skating revues are a feature of the entertainment. With the program finished, the floor can be quickly resurfaced, if necessary, for dancing. There is a rink of this kind in the Persian Room of the Sir Francis Drake Hotel in San Francisco, Calif. It measures 19x30 feet and has a ¾-inch coat weighing 3½ tons, or approximately 2½ tons more than genuine ice of the same dimensions and thickness would weigh.

SOD CUTTER IN ACTION
This 1-man machine is designed to cut sod up to 3 inches thick in one strip 24 inches wide or in two 12-inch strips, as may be desired. The work is done by a pitman bar with saw-tooth knives operated by a 21-hp. gas engine. It is said to have a capacity of 500 square yards an hour when traveling at the recommended speed of half a mile an hour. The unit is shown with E. C. Gledhill, its inventor, and with the protective hood removed.

Building a Dam Under a "Big Top" to Keep the Earth Fill Dry

WELL-conceived plans occasionally have to be changed, and that has happened in the case of the Government's flood control project on the White River in the State of Washington. The contract for the Mud Mountain Dam, which is to span a narrow canyon near Tacoma, originally called for a rolled, impervious earth-fill structure. It was to have a core of sand and gravel mixed with blue glacial till and a shell of sand and gravel, all to be compacted at nearly optimum moisture content in layers 6 inches thick.

As revised, the dam will have an earth-fill core as specified, but it will be flanked by tapering transition zones of fine material 50 feet wide at the base and have outer sections ranging from coarse to large quarry rock. The change was necessitated when it was discovered that the sand and gravel from the available borrow pit, located on the right bank of the stream and 1½ miles from the dam site, contained an excess of fine material and had too high a residual moisture content. This was borne out by a test fill, 5 feet high, which would not consolidate because the mass would neither drain nor dry. Now come the interesting features of the work that are the direct result of the failure of the sand and gravel in its natural state to meet requirements.

Three oil burners, each of 1,000 hp., have been installed at the dam site, together with screens, belt conveyors, and drums, for the purpose of drying the core material—427,000 cubic yards of it. It is estimated that each burner will consume approximately 330 gallons of oil per hour when operating at full capacity and will reduce the moisture content of the material passing through its associate drum to 10 per cent, which is the maximum for adequate compaction. From the drying plant it will be carried by a covered conveyor to bunkers at the rim of the gorge, from which point it will be lowered to the canyon floor in 8-cubic-yard dump buckets. There it will be spread by scrapers and then rolled, as already mentioned. In order that the work of the driers may not be counteracted during the rainy season, the core-placing operations are to be conducted beneath a huge tent that has been made especially for the purpose.

Mud Mountain Dam will be 425 feet high; 90 feet long at the base and 700 feet, exclusive of the spillway, at the crest; 1,600 feet wide at the bottom and 50 feet at the top. The core will taper in thickness from 300 feet at the base to 30 feet at the crest. The entire structure will call for the use of 2,109,000 cubic yards of earth-fill and rock, and is being built at an estimated cost of $8,000,000 by the Guy F. Atkinson Company.

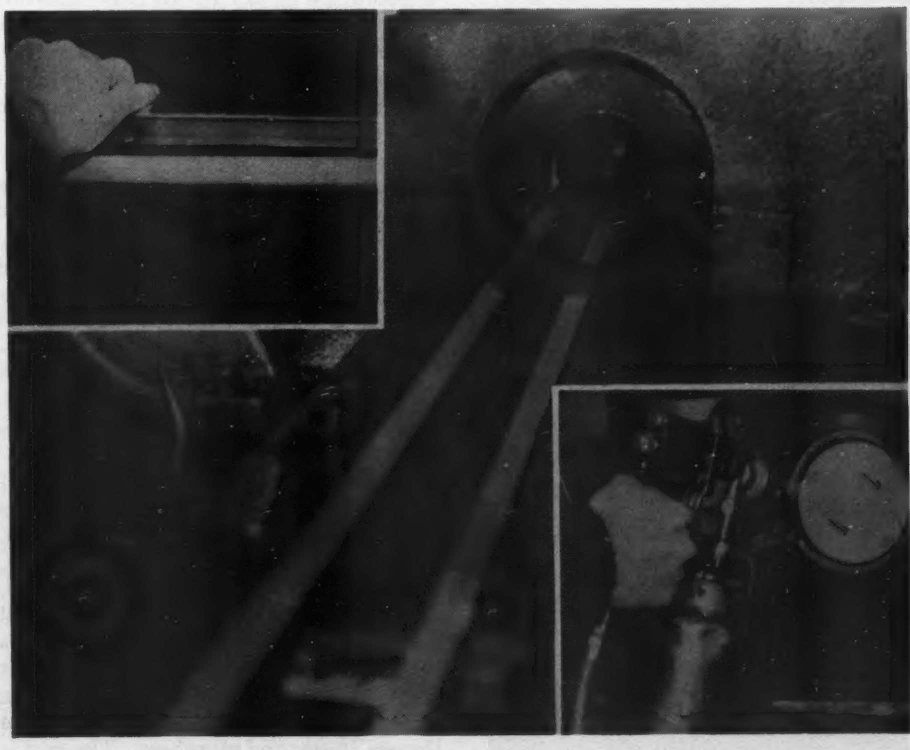
Railroad-Crossing Warning

STOP, Look, and Listen—the familiar warning sign at railroad crossings is disappearing. It apparently takes something more than that nowadays to make the average motorist railroad-crossing conscious. At the Illinois Central Railway main-line crossing north of Grenada, Miss., on State Route 7, a big structure straddles the highway and in conspicuous letters cautions the approaching traveler that danger lurks ahead. When a train comes within 2,300 feet of the spot a siren begins to sound and an electrically controlled Neon sign, reading Stop—Death—Stop and bearing a skull and crossbones as well as a directional arrow, starts to glow—the word Death flashing on and off every two seconds until the train has passed and the signal is cut off. To prevent failure of the system, each word is on a separate transformer hookup, and two double-faced red stoplights and a siren are automatically operated from batteries should there be an interruption in the 110-volt alternating-current circuit. Records show that the service costs less than $4.50 a month.

Colloidal Graphite a Lubricant for Extrusion Dies

IN MAKING architectural and other shapes of aluminum alloys by the extrusion process, the Detroit plant of the Revere Copper & Brass Incorporated is using colloidal graphite to lubricate the dies. It has been found by test that this film makes it possible to increase the number of "pushes" between successive redressing operations by 20 per cent, on an average, and to improve the product to such an extent that the amount of scrap material resulting from surface imperfections has been considerably reduced. The lubricant consists of an Acheson colloidal graphite concentrate thinned with a distillate of 200 seconds viscosity. This is suitable for dies that are still warm from use. When they are cold, the dispersion is thinned further with carbon tetrachloride. The solution is applied with a regulation-type spray gun, the dies being coated each time they are removed from the extrusion machine for redressing.

The sections produced by the extrusion process range from varying shapes such as window frames, sills, angles, T's and Z's to thin ribbed and corrugated forms suitable for moldings and cover strips. Application of the colloidal graphite has proved to be especially advantageous in connection with thin sections that also have decorative value and require a consistently smooth, bright finish.



INCREASED PRODUCTION—LESS SCRAP

In the center is pictured the discharge end of an extrusion machine with aluminum-alloy molding issuing from the die inside of it. The insert at the left is a reproduction of an untouched photograph showing, top, a strip of molding that was rejected because of surface defects, and, below it, an acceptable piece made with dies lubricated with colloidal graphite. Note the high surface brilliance of the latter. The film is applied to the dies by an ordinary spray gun (lower insert) using air at 75 pounds pressure per square inch.

Industrial Notes

Ampco metal is sparkproof and is used to make shoes for mules used around powder plants for haulage.

Vibrating screens woven of stainless-steel wire are finding favor in ore-dressing plants where they are being used in place of rake classifiers for sizing the concentrates of certain kinds of ore. They are made by the W. S. Tyler Company.

Such a little thing as adding an odorant to cooking, heating, and illuminating gas has made it possible for a public utility in Cincinnati, Ohio, to cut the cost of detecting gas leaks in mains and service pipes from $23.80 to $0.77 each. There is nothing new in this practice; but figures as to the actual savings effected in consequence are not usually available.

Hanna air and hydraulic cylinders and associate products such as valves and brackets are described in detail in Catalog 230 recently published for free distribution by the company. The bulletin contains illustrations and line drawings of the different models, together with engineering data, specifications, etc., of value to users in making selections. Copies may be obtained from the Hanna Engineering Works, 1765 Elston Avenue, Chicago, Ill.; but requests must be written on company letterheads.

Work in process of production in machine shops sometimes covers considerable ground before the cycle of operations is completed. This involves a time loss that grows in proportion with the number of stops that have to be made. To reduce this lost motion to a minimum, the Warren Steel Specialties Corporation has developed a carriage on which can be mounted any desired light-weight equipment that ordinarily is stationary or too heavy or awkward to handle. The portable unit, one of which is shown, will permit a workman without a helper to carry a number of tools to the work rather than the work to the machines. The carriages are designed to meet individual requirements and are built in any practicable size of heavy-gauge auto-body sheets. They are also suitable for outdoor use on construction jobs.

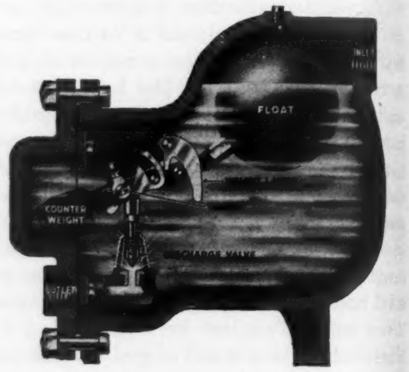
Clear or frosted electric-light bulbs of special construction to resist vibration set up by motors, machinery, vehicular traffic, etc., are being offered by the Wabash Appliance Corporation in 100-, 150-, and 200-watt sizes and in nine separate voltages: five from 110 to 130 and four from 220 to 250 volts. The new lamp has a flexible, short stem, and the filament is cushioned against shock and concussion by means of four molybdenum pigtail springs welded to six flexible supports. It is said to have an average burning life of 1,000 hours.

In the course of experiments with seasoning lumber, members of the staff of the U.S. Forest Products Laboratory at Madison, Wis., have discovered a wood-plasticizing process that is being patented by the Government and for which licenses are to be granted. Soft and hardwoods soaked in a concentrated solution of urea and then dried become plastic when subjected to a temperature of 221°F. In that condition it is possible to bend, twist, and compress the materials, which, upon cooling, will not only retain the shape given them but will also resume their normal hardness and rigidity.

Sherman Paper Products Corporation has announced an addition to its line of Corroflex—a corrugated, cushion packing material with crisscross indentations and an outer covering of Kraft. The new product is intended for the shipment of metal and other parts that require protection against moisture, and is made with an extra duplex sheet lined with asphalt. Aside from being waterproof it is said to be highly resistant to puncturing, abrasion, and breakage. It is available in an all-purpose weight in sheets cut to size and in rolls ranging in width from 6 to 72 inches.

It is reported from Russia that large-scale experiments with hydraulic coal mining, previously mentioned in this MAGAZINE, have been so successful that plans are underway to introduce the system in numerous collieries in the Urals, the Donets Basin, and elsewhere. The coal is cut by powerful streams of water delivered by monitors, the water serving at the same time to transport it underground by way of pipe lines or ditches. Aside from increasing production per man, worked-out areas in hydro-mechanical mines do not have to be entered and therefore not supported, thus greatly reducing the danger of roof falls to which the men are normally exposed.

Designed for pressures up to 125 pounds, the Model JR Nicholson weight-operated trap shown in the accompanying illustration automatically drains water and oil from air receivers, aftercoolers, separators, etc. It comes in one size only with a ½-, ¾-, or 1-inch inlet and ½-inch outlet with screwed connections. Water entering the trap raises the float to its highest point of travel where it releases the weight latch that allows the counterweight to fall. The latter causes the crank to which it is attached to lift the discharge valve wide open instantly. It is held in that position by a link latch until the emptying water has carried the float to its lowest point of travel. Then the weight latch again engages the counterweight, the link latch is disengaged, and the valve is closed. The manufacturer points out that the Model JR is not what is commonly termed a float-operated trap. The float is instrumental only in releasing the counterweight which, as it drops, opens the exhaust valve. The approximate unit discharge of the trap is 5½ pounds, or 2,465 pounds per hour at 10 pounds pressure and 870 pounds at 125 pounds pressure.



What is described as a self-sanitizing and sparkproof floor material has been produced at the Mellon Institute under the supervision of Dr. W. A. Hamor. The preparation bears the trade name Hubbellite and has a chloride-of-copper base. It is applied like cement to either wood or concrete and forms a hard surface that is admirably suited for wash, shower, or locker rooms or where explosives or inflammable liquids are handled. It is claimed that when floors so treated are washed, traces of the copper compound are dissolved and prevent the growth of microörganisms, thus effectually preventing the spread of contagious skin diseases such as athlete's foot. Hubbellite has been put on the market by H. H. Robertson Company, Pittsburgh, Pa.

FEATS & FACTS

By Robert W. Glueck

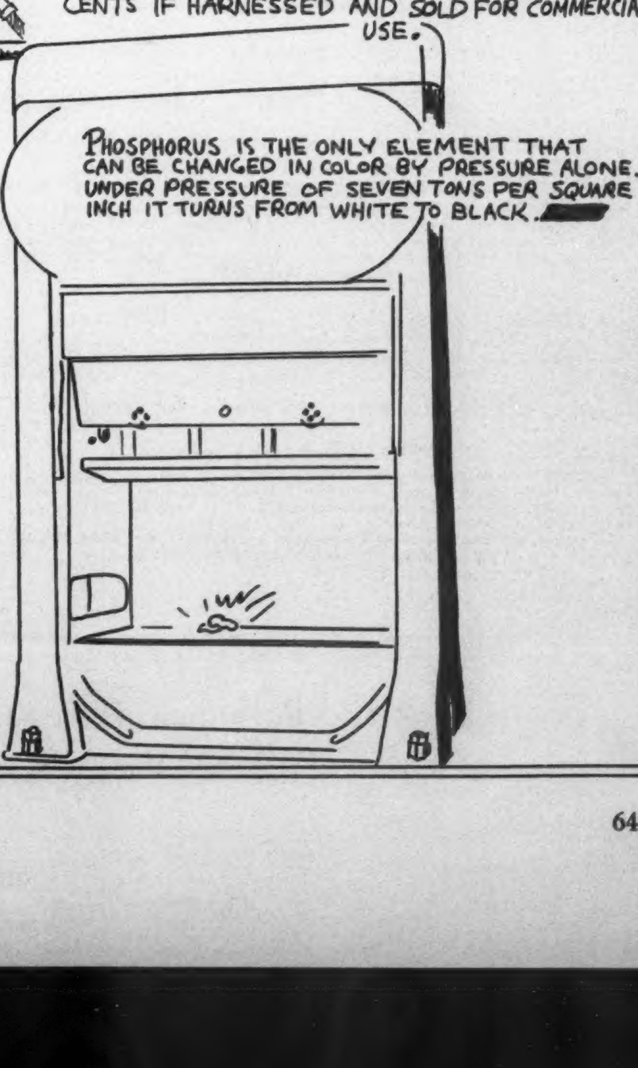
SOME MAKES OF AMERICAN AIRCRAFT ENGINES ARE BUILT WITH SUCH PRECISION THAT EVEN THE TOUCH OF A PERSPIRING FINGER WOULD CAUSE SUCH CORROSION AS TO RUIN THE PART BECAUSE ITS MIRROR-LIKE FINISH CANNOT BE REPOLISHED WITHOUT AFFECTING ITS DIMENSIONS.

SPIDER WEB SILK IS USED IN THE LENSES OF PRECISION INSTRUMENTS, SURVEYORS' TRANSITS AND THE LIKE. EACH FILAMENT IS A LITTLE MORE THAN THREE TEN-THOUSANDTHS OF AN INCH THICK, OR ABOUT HALF AS WIDE AS THE FINEST LINE THAT CAN BE SCRATCHED ON GLASS WITH A DIAMOND-POINTED TOOL.

THE AVERAGE FLASH OF LIGHTNING, DESPITE ITS TREMENDOUS VOLTAGE AND POTENTIAL DESTRUCTIVE POWER, WOULD NOT BE WORTH MORE THAN TWO CENTS IF HARNESSED AND SOLD FOR COMMERCIAL USE.

A NEW COMPRESSED-AIR GUN SPRAYS MOLTEN METAL AT RATES VARYING FROM AN OUNCE UP TO TWO-POUNDS PER MINUTE AND IS USED TO FILL TEETH, BUILD UP DENTED AUTOMOBILE BODY SURFACES, COAT OBJECTS TO PREVENT FIRE, CORROSION OR CONTAMINATION AND, WITH THE USE OF STENCILS, TO PAINT SIGNS and DECORATIONS.

PHOSPHORUS IS THE ONLY ELEMENT THAT CAN BE CHANGED IN COLOR BY PRESSURE ALONE. UNDER PRESSURE OF SEVEN TONS PER SQUARE INCH IT TURNS FROM WHITE TO BLACK.



o to

E.,

efer-
ace-

ok a

ures
ttle,

G

with
s in
ation
given

and

ugh-

ppli-
illing
mber
nner.

and

; and

Croft

data

of the
t and
cable

ok to
with
Diesel
Cater-

ht
p.

azine